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introduction

"In a world filled with the products of scientific inquiry, scientific literacy has become a necessity for everyone. Everyone needs to use scientific information to make choices that arise every day. Everyone needs to be able to engage intelligently in public discourse and debate about important issues that involve science and technology. And everyone deserves to share in the excitement and personal fulfillment that can come from understanding and learning about the natural world" (National Research Council 1996, 1).

"If a child is to keep alive his inborn sense of wonder, he needs the companionship of at least one adult who can share it, rediscovering with him the joy, the excitement, and the mystery of the world" (Carson 1965).

How do we keep alive this inborn sense of wonder in early childhood classrooms? How can teachers provide children with appropriate experiences and guidance? Using theYoung Scientist series is one way. But before we describe the series and how to use this guide, we would like to share a few responses to two important questions: (1) Why is science knowledge important? and (2) Why should we start in the preschool years?

Why Is Science Knowledge Important?

One goal of science is to understand the natural world. Knowing some science can help us explain things that happen, such as why water evaporates and why plants grow in particular locations, what causes disease, and how electricity works. Scientific knowledge also can help us predict what might happen—where a hurricane may hit the coast or how severe the flu may be this winter.

But science is more than knowledge; it is also a process of exploration that we call *scientific inquiry*. When scientists try to learn something about events, objects, or materials, they observe, wonder, and ask questions. And they go further and focus on one question, predicting what they think they might find out and setting up an investigation. They observe closely, using their senses and tools to collect and record data and evidence. Through analysis of their data and reflection on all they've done, they develop new ideas and theories and communicate those to others.

Most of us are not scientists, but in many small ways, we do science. When you ask the question, "How much light does my geranium need to flower well?" and then test the different possibilities by putting one in the sun and one in the shade to find the answer, you are doing science. When you compare two pens, predict which one you think will work best for the drawing you are making, and then try them out, you are doing science. When you use a book to find out what kind of birdseed will attract cardinals, you are doing science.

Whether we work in a lab or a school, chart the course of hurricanes, or want to learn about sound, we all have questions—scientists and nonscientists, adults and children alike—and we all use some of the basic tools of scientific inquiry. Given the opportunity to explore and discover, we all can feel the sense of wonder, joy, and excitement that Rachel Carson describes above.

Why Should We Start Science in the Preschool Years?

Children's curiosity about the natural world, their "inborn sense of wonder," is a powerful catalyst for their work and play. With this curiosity and the need to make sense of the world, children are motivated to ask questions, explore how things work, and look closely at the natural world around them.

But in today's world, children's experiences and their opportunities to do science are often limited—confined too frequently to the passive and secondhand experience of the television or video game. Modern technology also has hidden from view some of the basic ways in which things work. Our food comes from stores and few children have seen or engaged in growing and processing it. Toys that were once pushed or pulled or rolled now have hidden motors and batteries to drive them and a switch to turn them on and off.

Science curriculum is important in the early childhood classroom so that "doing science" becomes a natural and critical part of children's early learning. With carefully selected materials and thoughtful guidance, children's explorations will encourage them to observe more closely, develop new ideas about the world, and build a foundation of experiences and ideas on which to construct later understanding. Science in early childhood classrooms also provides a rich context in which children can develop other important skills, including large- and small-muscle control, language and early mathematical understanding, and cooperation.

What Is the Young Scientist Series?

The Young Scientist series is a science curriculum for children who are three to five years old. Each of the teacher guides provides background information and detailed guidance on how to incorporate science into your daily program using many of the materials you already have in the classroom in new ways. *Discovering Nature with Young Children* is about the living things right outside the classroom door. *Exploring Water with Young Children* takes a new look at the water table and *Building Structures with Young Children* challenges children to use building materials found in the classroom to explore questions of how to make things strong, tall, or elegant. Each study can take several months or extend over longer periods of time.

The Young Scientist series is not about learning and repeating facts, information, and vocabulary with little direct experience. It is not following a set of directed activities or learning the scientific method. It is not a week focused on bears and it is not observing random objects on a science table. The Young Scientist series makes science the work and play of exploring materials and phenomena, while providing opportunities for children to learn from that experience. Young children may do this as they engage in fantasy and dramatic play—creating magic potions at the water table or building a home for the make-believe turtle in the block area. They may do science as they challenge themselves or invent a game: "Who can build the highest tower or empty the water bucket the fastest?" They also may engage in exploration as young scientists, wondering and questioning and seeking to make sense of the world: "What would happen if I rolled the ball from the very top of the ramp? What does my worm need to live? I wonder if I can find an anthill near the one we found yesterday?"

As they explore and interact with one another, young children try to make sense of what they see and do. They develop early theories about why things are the way they are, act the way they do, and how they relate to one another. As their experience broadens and their thinking deepens, their ideas and theories become more plausible and closer to current understandings in science.

Exciting science experiences for young children do not just happen. The Young Scientist series describes the teacher's important role to ensure that children's play and ideas about science are focused, deepened, and challenged. The following examples illustrate the differences between activity-based block study, a thematic approach, and an in-depth exploration of the science of building structures.

Teacher A opens her block area during choice time. A small group of boys uses the area to build roads and play cars. They lay unit blocks end to end for their roads and make a bridge to go over the quicksand. The boys especially enjoy crashing their cars into one another. Later that week, the teacher borrows a play rug printed with roads, signs, and buildings, and lays it down in the block area. The next morning, the boys return to their block area to enjoy "zooming" their cars around the rug's roads. The boys place blocks on different parts of the rug to represent a gas station, their school, and a video store.

In this example, the children actively enjoy playing with the cars and blocks in the block area, but opportunities for both independent and cooperative learning are limited. The cars and blocks stimulate their interest, but there is no guidance or encouragement for them to investigate ideas such as the ways blocks can be stacked and balanced to make garages and bridges, or the physical characteristics of the building materials. Children's interest and curiosity are clear, but the potential for reflection, dialogue, and developing ideas about some interesting and critical physical science concepts is minimal. Moreover, there is little attention paid to the fact that only boys are using the blocks, or to developing strategies to give all children opportunities to build.

Teacher B notices the children's interest in cars and decides to do a project on bridges. She gathers many materials: additional cars and a train set for the block area; books about bridges; a poster of the Golden Gate Bridge; a board game involving train tracks that wind over and under one another on bridges; and a new cityscape puzzle that includes the George Washington Bridge. She plans to use the opportunity to teach the letter *B* to the children as well as the group game London Bridges. The teacher introduces the project with a class discussion asking children to share their experiences with bridges. She identifies the areas in the classroom where there are bridge activities and encourages children to spend some time at each. During the week, she moves through the classroom supporting children's play and, during group time, encourages them to talk about the bridges they've been building for their cars and trains, and share what they've learned about the different kinds and shapes of bridges. Toward the end of the project, the children make a special trip to a train station, take a ride on a train, and count the number of bridges they go over.

In this example, children are surrounded by bridge activities. The block area, the library corner, and the manipulative table have bridge-related activities. The basic literacy, math, and social skills the teacher is focusing on are addressed through these activities. The children are engaged, and visiting the train station and riding on the train are highlights of the week. But this project with its bridge theme has little to do with scientific inquiry and exploration of science concepts.

Teacher C also responds to her children's interest in cars and roads. But she decides that their interest could be the beginning of an exploration of building structures and building materials. When children build roads for their cars, she observes their play and, in the context of their story line, invites them to make multistory parking garages for their vehicles. The next day, she uses a few minutes of group time to show children photographs of the outsides and insides of local parking garages. She also shows them cardboard pieces and roof boards and mentions that she'll be putting them in the block area and at the building center where, ahead of time, she's placed two large boxes of table blocks and a set of small cars. She introduces dollhouse people that will be added to the block area, and three children who haven't shown interest in block play before ask to play there. The children request keeping their roads and garages up overnight so they can continue their play the next day, and she agrees. She also suggests they use the clipboards and paper at the block area to draw their structures, just in case they get knocked down. At the end of the day, the group gathers to share a few memories from the day. The teacher invites one builder to share her problem of adding a third floor to her parking garage, and her solution to stand cylinder blocks in the middle of the second floor to support the third floor.

As in the other examples, children are enjoying playing with the cars and the blocks, but in this case they are engaged in an active, hands-on science inquiry project that illustrates the approach of the Young Scientist series. The teacher builds on the children's interests and has defined a clear set of science concepts to guide their work with blocks. While many other skills are practiced and learned, science is in the foreground.

She focuses the children's attention on important concepts about physical science:

- Forces of gravity, tension, and compression
- Design, stability, and balance
- Characteristics of objects with which children build (such as shape and size)
- Characteristics of materials of which objects are made (such as wood, foam, or plastic)

She encourages deeper thinking to enrich their experiences without interfering in their own process of questioning and exploration. As she does this, the children develop their skills in the following:

- Observing closely
- Raising questions
- Investigating
- Representing things and ideas
- Analyzing

Her questions focus the children's attention on specific designs and strategies they've used to build bridges, and how different blocks respond when used in construction.

As you continue to read this guide and begin to use these techniques, you will learn more about science for young children and what they can do. You will also learn about how to make it possible for children to engage in the rich science exploration exemplified by Teacher C. As you teach, keep in mind these basic principles of the Young Scientist series.

- All three- to five-year-olds can successfully experience rich, in-depth scientific inquiry.
- The content of the science learning draws from children's experiences, is interesting and engaging, and can be explored directly and deeply over time. Expectations are developmentally appropriate; that is, they are realistic and tailored to the strengths, interests, and needs of individual children.
- Discussion, expression, representation, and reflection are critical ways in which children make meaning and develop theories from their active work. Children learn from one another.
- Teachers can take on specific roles and use particular strategies to actively support and guide children's science learning.

Rationale and Goals

Structures are everywhere. Some, such as houses, towers, walls, fences, playground equipment, and billboards, are constructed by people. Others are natural, such as trees, cliffs, and skeletons. Surrounded by structures, it is no surprise that young children are often enthusiastic about building their own.

Many young children have had experiences building either at home or in early childhood settings. Most classrooms provide blocks of different sizes and shapes, as well as additional materials to encourage building and acting out ideas and fantasies. *Building Structures,* however, will focus children's explorations and deepen their understanding of the physical science present in building.

The specific goals of the exploration are to provide opportunities for children to

- Build with a variety of different materials.
- Experience the ways forces (gravity, compression, tension) affect a structure's stability.
- Build an understanding about how the characteristics of materials affect a structure's stability.
- Develop science inquiry skills including wondering, questioning, exploring and investigating, discussing, reflecting, and formulating ideas and theories.
- Develop scientific dispositions including curiosity, eagerness to find out, an open mind, and delight in being a builder.

The Classroom Environment

One of the most important roles you play in this exploration is to create an environment and culture in your classroom that supports and encourages children's building—the classroom must convey the excitement, challenge, and wonder of building with many different materials. Some of the characteristics of such an environment and culture follow.

The Importance of Building

A building environment conveys the importance of building structures of all kinds. By providing many kinds of blocks (made from wood, foam, and plastic) and other building materials (such as clay, cardboard, and wire), you create a building environment that challenges children to build in different ways. In the building environment, there is enough space and time to build complicated structures and even leave them standing for further discussion and work. Pictures of buildings and blueprints on the walls and books about buildings placed around the classroom provide children with images of different structures and their characteristics. This importance is also conveyed on walks around the neighborhood as you notice buildings and other structures, and discuss how and of what they are made.

An Emphasis on Inquiry

Builders ask questions, observe closely over time, and think about what their observations tell them. What are the special characteristics of the building they are trying to make? What materials would best suit this building project? How can they make a building that is strong enough to house their dinosaurs? A building environment encourages such questions and ideas as well as opportunities for figuring them out.

Sharing Observations and Ideas

In a building culture, children are encouraged to share their building experiences and ideas through small and large group discussions, and they learn to listen to what others have to say. They share their records of what they built; their ideas about science concepts, such as what makes a tower stable; and how different kinds of building materials affect a structure's integrity. They learn that ideas are valued and important whether right or wrong; that people may have different ideas; and that one can learn by asking questions of others. They also learn that they need to share how and why they know what they know as well as what they know.

Documenting and Recording Observations and Ideas

Builders spend a great deal of time representing and documenting what they do—using careful sketches and descriptive words to most accurately remember their experiences and share what they have noticed and learned from their explorations. Some builders begin to use drawings to help them plan too. Builders can begin to develop these skills no matter their level of development. In a building environment, materials for representation are easily available and children's work is used to discuss their ideas and stimulate more focused investigations.

Children as Builders

This exploration is designed to provide experiences over time in which children can engage in multiple ways depending on who they are and what they bring. You may find that some children are immediately drawn into the exploration, using everything you set out. Other children may be more reluctant, shying away from the building materials. Some children will quickly grasp the ideas and strategies for building towers and enclosures, while others struggle with these ideas. How children approach this exploration, and what they learn, is influenced by a range of factors including their different developmental levels, experiences, needs, skills, and ideas. As you prepare for this exploration, you will need to consider these factors.

Prior Experiences

Young children bring to an exploration of building their own ideas, interests, and beliefs based in experience and culture, and tempered by their developmental level. Some children may have had more opportunity to play and build with blocks and other materials both indoors and out; others may have had less opportunity. You might find that some of your girls avoid the block area and need specific encouragement to build. Table blocks can be a starting place. Having a time in the block area just for girls or connecting building with the dramatic play area are other possible strategies.

Diverse Strengths and Challenges

Any class presents you with a diverse group of children. All children can explore materials and objects; all children try to make sense of their environment. Each child in your classroom can engage with science and contribute to the classroom learning whether she is three or five years old, speaks English or Spanish or Creole at home, is typically developing or has a special need.

The *Building Structures* exploration relies heavily on children's hands-on building experiences. Be sure that all children, including those with disabilities, have opportunities to observe and explore building structures. As you plan, consider environmental adaptations you may need to make (such as how to arrange the space and how to place the materials so that all children know where to find them and can access them easily). Also think about curriculum adaptations (such as using visual cues or body language to convey information to children whose first language is not English) and materials adaptations (such as having blocks on a table if a child cannot be on the floor) that can support children's participation. Remember that some children may have little experience engaging in play, either alone or with others, and may need you to model and encourage.

Communication Skills

As with all science, describing and recording what is planned, what actually happens, what is observed, and what happens next is essential. Children will have varying levels of observation, language, and representational skills depending on experience and developmental level. Some children may not have the use of many words to describe what they see but may use their bodies and actions instead. Others may draw with great detail. The drawings of others may only include one major characteristic of a building; for example, a line may represent a tower, or a box may represent a block. In each case, an important characteristic of the building guides the representation. Some children will document what they see using three-dimensional materials. It is important to encourage thinking and representation without expecting or pushing children to go beyond their capabilities.

Children's Ideas

Through their explorations, children will experience the force of gravity pulling their buildings down and the design challenges of building different kinds of structures with different kinds of materials. As you observe children's block building, you will notice responses, both behavioral and verbal, that may provide a window into their thoughts and ideas. You will also notice the building strategies they use. As children place blocks one on top of the other, they may instinctively balance each block. If they see it begin to fall, they may try another way. In the early stages of building, knocking a building down (theirs, not those of others) is part of the learning as well.

Given a variety of different materials, children will become skilled at selecting those they need to do what they want. They may find that the unit block cylinders are the best for building a tall tower. They may discover that the squishiness of foam blocks is a problem if they want to put heavy weight on a building, but that the lightness of the blocks is perfect to build the top of a tower. They may find that straws and connectors make good towers because they are light and long, but if the structure gets too high, it tips or pulls apart when more weight is added. They are likely to choose waffle blocks when they want to build a house big enough to get into because the joints interlock and keep the blocks from pulling apart. Through conversation, questions, and gentle probing, some children will come to new understandings about structures and the forces involved. Other children will need repeated exposure to ideas and experiences over extended periods of time to let go of old ideas and begin to refine and deepen their understanding.

The questions children have also may be very different from the ones you have. You cannot know what every child in your group is thinking, but you may get an idea of different children's points of view by listening to, questioning, and observing children as they explore. It also is helpful to think about some of the typical ideas, questions, and naïve conceptions young children have about some of the basic science concepts that are related to this exploration. You will find information about some of the more common ideas children hold in step 1 of the "Getting Ready" section (p. 13).

Science Exploration through Play

Play is fundamental to children's development, and they approach much of what they do through play. Children engage in many kinds of play when building, including dramatic or symbolic play, exploratory play, and constructive play (Eisenberg 2000). Constructive play permeates what children build; they often engage in dramatic and fantasy play with blocks as they build police stations, zoos, castles, and houses. For some children, props such as human figures, animals, or cars will entice them into the building area. Regardless of what children are building, these situations offer opportunities to extend their thinking and building through encouragement and such questions as, "How high do the walls need to be to hold the elephants?" and "How can we make the castle tower very tall?" Some children will find the building process itself intriguing and engage in exploratory play as they try to balance one block on another, figure out which kinds of blocks will make the tallest tower, or work to build a foundation stable enough to hold up a wall.

You will also want to encourage symbolic play in this exploration by asking children to assume the role of construction workers, architects, engineers, or masons. Books, a guest visitor, and props related to these roles give children some of the information and tools they need to create this kind of symbolic play.

Connections between Science Outcomes and Other Domains

As you provide opportunities for children to explore building materials, and guide them in their development of science inquiry skills, you will also see growth in language, literacy, mathematics, and social skills, as well as in children's approaches to learning. The chart that appears in the appendix (pp. 97–103) shows the connections between science inquiry outcomes as we define them in the Young Scientist series and the outcomes of other subject areas taken from the Head Start Child Outcomes Framework.

Mathematics is one of the languages scientists use to record and reflect on their observations and to communicate their ideas to others. Children who are exploring building materials will also become meaningfully involved with mathematics as they build with blocks and other materials. The blocks themselves are of many geometric shapes; as children build with them, they can experience these different shapes. They can also notice relationships between the unit blocks such as how many square blocks they will need to make a wall the length of one long block. They will experience the symmetry often needed to make towers balance and the patterns (such as in a brick wall) that help make structures stable. And, of course, as they build towers and enclosures, there are endless opportunities for measurement. Some children will simply experience these mathematical concepts, others will talk about them, and still others may use them explicitly as they build.

Scientists also communicate with words. As children communicate their findings, participate in discussions, and represent their experiences they are certainly increasing their language and literacy skills. In fact, research suggests that engaging children in rich science experiences provides a context and a purpose for meaningful language and literacy learning. By engaging with science, children build their vocabulary while developing an ability to communicate their ideas. Such a capacity for oral language provides the foundation for all literacy learning. Children also learn about the importance of books as they use them to get ideas about building techniques, materials, and designs. They learn to record their observations, explanations, and ideas about stability by using multiple forms of representation, including drawings, simple graphs, and writing. Such representations provide a visible record that encourages children to reflect on and talk about their theories and what they have discovered.

Science is a social activity. Whether in person or through other means of communication, scientists exchange ideas, build on one another's work, and often collaborate on science investigations. As children pursue their questions about what makes structures stable, they need to work together to compare findings. Together their individual ideas can suggest a bigger picture and new ideas—placing a flat wooden roof board on top of four wobbly unit block walls will often steady the walls. Such collaborative work (that involves sharing materials and ideas) provides children with significant opportunities for developing their social skills.

Making the Most of the Curriculum

Teachers who implement the Young Scientist series will use a specific approach to teaching: a set of strategies that balance the children's rich explorations with some more structured activities. This curriculum and the accompanying tools and resources are designed to support you as you learn to use this approach. As you prepare to implement *Building Structures with Young Children,* we encourage you to focus on four basic aspects of teaching in a way that may be new to you: the science, the physical environment of the classroom, time and scheduling, and the facilitation and guidance of children's learning.

Science

You do not need to be a scientist to implement this curriculum. But in order to be responsive to children's explorations, you need to recognize and experience the science phenomena children are experiencing. There is no better way to build this understanding than to engage with the science. When you observe a child working to solve her building problem, you will be much better at guiding her if you have had experiences solving your own. When children raise questions about how to build tall towers, your observations and experiences will help you suggest what children might focus on and what you might show them in a book or tell them. You will appreciate the challenge of drawing a block structure if you have tried it yourself. Before introducing *Building Structures with Young Children*

to children, take time to be a builder yourself. You will find activities to guide you in step 1 of the "Getting Ready" section on p. 13; this section will also help you understand common ideas children have about the building materials around them.

Physical Environment

Science for young children is about investigating real things, developing new ideas and theories, and sharing them with others. The richer and more varied the environment is, the richer and more varied the experiences the children will have. In addition, children's exploration will be more independent and sustained if the tools they need are readily available where and when they need them. You will find guidelines for setting up this environment in steps 3 and 4 of the "Getting Ready" section and in the preparation section of each step. Additional ideas are provided in the resources section.

Time and Scheduling

Scientific inquiry takes time. Finding out how different building materials respond to being stacked and combined requires weeks of choice time. Focused inquiries into the strategies, designs, and materials used to construct tall towers and sturdy enclosures can last for weeks. As children become engaged, you may find the building going on for three or more months, not just the two you anticipated. A typical schedule often does not include regular time periods of forty-five minutes to an hour and yet this is what is needed for groups of children to study something closely. Often the program calls for a new theme or topic weekly or every two weeks, but *Building Structures with Young Children* should go on for two to three months with some observations and activities spread out across the year. Suggestions for scheduling different activities are provided in the "Getting Ready" section and throughout the guide. You will also find suggestions for making extended study possible.

Facilitating and Guiding Learning

With your own building exploration under your belt, a physical environment that invites and supports children's inquiry, and a schedule that allows the time, the stage is set for the most important part of teaching—your interactions with the children. There may be some new strategies to learn, new expectations required, and old approaches to let go of. This guide is designed to help you become a teacher of science—engaging children in science and focusing and deepening their experiences and thinking. The step-by-step guide is designed to help you as you learn new roles and approaches.

Involve Families

Families are important to *Building Structures with Young Children*. In cases where parents are not the sole caregivers, you can involve a grandparent, foster parent, aunt, uncle, older sibling, or cousin. As you involve families, consider how culture might influence a child's block play. For example, some families may assume block play is for boys; some families may discourage children from playing with blocks or other open-ended building materials; others may come from cultures where children are expected to listen, not to mess about. Talk with family members to learn about their cultures and children's experiences. This knowledge will help you engage families appropriately and respectfully.

And families have much to share about their children. Individual children may have had interesting or problematic experiences playing with blocks that are important to know. Some children may have built clubhouses, tree houses, or other structures at home. Others may have had a bad experience being bossed around by other builders or criticized for their efforts. They may have relatives who are contractors, carpenters, plumbers, bricklayers, construction laborers, or architects. Families can provide you with important clues about such experiences as well as what building materials intrigue their children, what questions they have, and what strategies you might use to support children's learning.

Take steps at the beginning to inform families about *Building Structures with Young Children*—what you will be doing, what children will learn, and why this is important for children's development. Feel free to use or adapt the sample letter on p. 83 that introduces families to the exploration. If a caregiver does not speak English, find someone to help you translate the letter or make an audiotape in their home language. Also invite families into the classroom or host a family night where families can experience firsthand the importance of your science explorations and experiment with ways to promote children's explorations of structures and building at home and in the community.

Be sure to let families know that their participation is welcome and needed and that you are interested in

having them share their expertise as well as their concerns. Family members can be rich resources if they have cultural stories to share, experiences building different kinds of structures, or knowledge about places to visit. Also, encourage family members to work as classroom volunteers. Some families may be able to help in the classroom on a regular basis; others may come in just for special occasions such as field trips or special events. They can serve as invaluable assets when you take the class outdoors, providing children with the adult guidance they need to help them focus and observe more deeply. Indoors, family volunteers can assist with small group explorations and ensure that an environment of respect for buildings and structures is maintained while children's curiosity is promoted.

Let parents know what they can do at home with their children. For example, they might build together. Suggest different building materials and experiences they might share. In addition to blocks, families can build with paper cups and sponges. They might also want to build a fort out of blankets and chairs. Family outings are another great way for children and families to see the science in their communities. Suggest places to go. For example, a trip to a local skyscraper or large auditorium can spark children's curiosity about tall towers and large expansive enclosures. Such activities can reinforce and extend the science children are learning in the classroom, while helping children and families see science phenomena in their daily lives. It is also helpful to provide sample questions that families can use to spark children's thinking and questions. The "Families Building Structures" handout included on p. 84 of the resources section provides families with ideas for activities and thoughtful questions they can ask their children. You might also provide families with a list of children's books that relate to the science concepts they are learning. See the "Books and Web Sites" section (p. 82) for some suggestions.

How to Use This Guide

Building Structures with Young Children includes three stages that will guide you in promoting children's exploration of building materials and structures and their use of inquiry.

Getting Ready. To facilitate this exploration, you will need to prepare. This section will help you to explore the science concepts embedded in this exploration. This section will also help you prepare the physical environment and think about routines and schedules that support children's inquiry into building structures.

Open Exploration. During this stage, children explore a variety of building materials at a number of building centers. These initial explorations are intended to encourage children to find out how they can build with these various building materials. During this stage, children will also look at books and images of different kinds of buildings to inspire their block play. This is the time to encourage children to follow their interests and try things out. Resist the temptation to share your own ideas about balance, stability, and characteristics of materials. Instead, encourage children to follow up on their ideas and try new things.

Focused Exploration. After children have had multiple opportunities to openly explore a variety of building materials, they are ready for focused exploration. During this stage, you encourage children to think more about how the materials and designs they choose make tall towers taller, or enclosures bigger. Your role is to deepen children's understandings by asking probing questions, encouraging children to represent their work, and creating opportunities for discussion and reflection. Extension activities—such as a field trip to a nearby construction site, the sharing of an interesting book or reference material, or a visit from a structural engineer—take place about once a week throughout "Focused Exploration." These experiences motivate children to continue their explorations in new ways, provide new information, and connect their work to their lives outside of school.

"Focused Exploration" includes two different studies. The towers study focuses on helping children look at the ways their choice of building materials, designs, and strategies affect a tall structure's stability. The enclosures study focuses on helping children look at the ways their choice of building materials, designs, and strategies affect the strength of the walls, roofs, stories, and other things they add to their enclosures.

Each step of "Open Exploration" and "Focused Exploration" includes the following sections:

The **core experiences** provide a rationale for the step—what science ideas you will be focusing on, why this is important for children, and how this step relates to the overall exploration.

The **preparation** section will help you get ready for each step as you consider your classroom schedule,

the materials you will need, and ways to connect with families.

The **teaching plan** offers detailed guidance for implementing the step, including what you might say and do to engage children and facilitate their explorations and help them reflect on their experiences and ideas. The left-hand column of this section guides you through the exploration. Issues teachers have raised and our responses are found in the right-hand column, which also includes photographs, drawings, and sample dialogue. This column gives you a picture of what the plan looks like "in action," while suggesting ways to extend science explorations.

The teaching plan is composed of three consecutive parts: Engage, Explore, and Reflect. Engage offers suggestions for what you might say and do to encourage children to get excited about and involved in building structures. Explore offers guidance for what you can do to facilitate their explorations. Reflect suggests different ways to use representation and discussion to help children reflect on their experiences and developing ideas.

At the end of the section on open exploration, you will find three different types of extensions for enriching children's building explorations. They include planning a field trip to explore different structures or a construction site, inviting experts into the classroom, and using books and videos to extend the exploration.

The resource section provides more information about the teaching approach of *Building Structures with Young Children,* essential information for working with buildings and structures; and book and Web resources. We encourage you to familiarize yourself with this section before you start. You will find references to the resources throughout the guide. Some of what is there may be useful to you right away; other material may be more helpful after you have had some initial experiences teaching *Building Structures with Young Children.*

Building High: Excerpts from a Teacher's Journal

These journal entries illustrate what one Head Start teacher learned when she helped her children in becoming young builders.

September 14

It's hard to believe that next week I'll have twenty children in my classroom! This year I plan to make the block area a more important place for kids' science learning.

I've already spent an afternoon exploring some of the open-ended building materials myself. I've had these materials in my classroom for years but never really thought about how they can be used to build, which ones are better for what, how to make stronger or taller structures, and much more.

I've also been working on my room. So far I've been able to make my block area almost twice the normal size. Somehow, making it bigger makes the whole area more important. I have a stash of building materials—unit blocks, foam squares and circles, and waffle blocks—as well as space for both hard and soft building surfaces. There's even room for a "Do Not Touch" table so kids can save their structures, and there's a table with clipboards and markers so kids can draw pictures of their structures. And I found some posters—one of Los Angeles at night and one of Paris. I found some great books at the library with pictures of interesting structures and stories about building. I have displayed many of these on top of the block shelves so the children can easily refer to them while working.

I guess what I'm really trying to do is develop a classroom culture—a classroom environment that yells *build.*

October 6

I feel like I'm really getting to know the kids and their families. As for the building theme . . . I got stuck. At first, the kids were really drawn to the blocks—how could they not be? But for a while, most of the fun was in knocking down the stacks they built up. So I've been trying to figure out how to focus the kids again on the building.

But I think I made a breakthrough. Just the other day I happened to sit in the block area during choice time. For a while I just observed, and somehow I think that my being there signaled to the kids that I was interested in what they were doing—that their play was important.

And I learned from watching them—seeing what was getting in their way, what their points of frustration were, and what they were trying to do. Alina, for example, kept placing one block on top of another, then one on top, across the two, like a doorway. After watching her try this for a while, I said that I noticed that the top block kept rolling off. She then got three of the long wooden cylinder blocks and tried to do the same thing. I think she understood that she needed to try different blocks but was unaware of the properties she needed to consider. This time the top cylinder rolled off, so I wondered out loud what would happen if she used a different block for the top piece.

Her response was to try a different kind of block for the top, and this time it worked! Then Reuben came over and began to copy Alina's explorations, beginning with the foam blocks. I'm beginning to see more clearly how the materials I present guide children's science explorations.

October 18

There are towers everywhere and kids are building towers with any kind of material they can get their hands on—cardboard blocks, foam cylinders, wooden cylinders, and unit blocks.

Today as I watched Reuben, Alina, and Joy building, I decided it was time to give them a challenge. So I pulled out some unit blocks, foam squares, and circles and asked which they thought they could use to build the tallest tower. I guess I was trying to help them think about the different materials—their properties, their limitations, and their possibilities. They really took up the challenge, trying to figure out what materials and strategies work best for building high. And now they're building even higher!

October 24

Today during group time we talked about towers and what it takes to build high. Here are some of their ideas:

- You have to put the blocks right on top of the other block.
- The tower stands up better if you build it on the roof-board blocks instead of the rug.
- Sometimes you have to move the blocks back and forth so the tower will stop tipping.
- Sometimes you have to take some blocks off.
- The tower will stand up better if you put some more blocks right next to the tower to help hold it up.

I wrote these ideas down. They will make a great documentation panel along with the pictures I took.

October 30

Kids keep building towers. Some kids built straight up. Kenya had a real design going and still got tall. Joy decided to build a brace. Miguel's was the simplest but the tallest.

And ever since I hung journals next to the blocks, kids have been drawing their towers too. Today they drew their structures from a couple different angles. They are working on drawing the exact shapes of the blocks they have used. We also started thinking of ways to measure their towers. I used the digital camera for the first time, which was neat because the kids could see everything from a different perspective right away. (Miguel could see how tall his tower was compared with his own height!)

November 15

Today Kenya, Avi, and Chris built a tower of large cylinder blocks. It was so tall they had to stand on chairs, trying to hold the tower to keep it up. When they asked me for help, I said that we needed to figure out why it won't stand up. After a few minutes, they balanced it, and it stood by itself.

When I asked how tall their building was, they got the poster of Miguel's tower. In the poster, the tower goes up to Miguel's mouth. So then they needed Miguel. Mia got him and asked him to stand next to the new tower. It came up to his shoulder. "So his is bigger," said Mia. But Chris can't believe it. He says, "Prove it." So Avi counts the blocks. He discovers that the photo tower has thirteen unit blocks. The new tower has eleven.

So this building stuff leads to new investigations—it's like new doors keep opening. In a way, it's about being there and really hearing kids' questions to figure out what they are working on and what they are trying to figure out. So what they need from me are the materials to work with, some guidance on method, the mechanics of how to systematize their explorations, and help documenting their discoveries.

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