



# An Early Head Start and Head Start Math Resource Guide



National Head Start  
Family Literacy Center

## High Five Mathematize!



High Five, High Five—Mathematize!  
To help our learning come alive,  
Five math strands make us aware,  
We can learn math anywhere!



Counting numbers-one, two, three.  
Math is fun for you and me.  
Two eggs, four eggs, six eggs, then;  
Enough for an omelet to feed our friends.



Quilts and baskets, braided hair.  
We find patterns everywhere.  
Clapping, chanting, singing songs;  
Patterns make our math skills strong.



You say ball and I say sphere.  
Learning geometry makes it clear.  
In, out, under, beside, around.  
Spatial sense won't let us down.



Measure children standing on the floor.  
One block, two blocks, three blocks, four.  
Longer, shorter, bigger, small.  
We're not the same, but we all stand tall.



In class, at home or on the run,  
Learning environments are the thumb.  
A hand of math strands opens wide;  
The High Five chant will be our guide.

**High Five, High Five—Mathematize!**

*High Five Mathematize: An Early Head Start and Head Start Math Resource Guide* was developed by the National Head Start Family Literacy Center for the Office of Head Start, Administration for Children and Families, U.S. Department of Health and Human Services under grant number 90YL0002/05, 2010.



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\* *La guía completa en español incluyendo videos y fotocopias son disponibles en el DVD que se encuentra en la última página.*

\* *The complete guide in Spanish, videos, and reproducibles are available on the DVD found on the last page.*







# Introduction

*High Five, High Five—Mathematize!  
To help our learning come alive.  
Five math strands make us aware,  
We can learn math anywhere!*



## The Importance of Early Childhood Mathematics

There are any number of practical and scientific answers to the question of math's importance. First and foremost, math is a life-long tool! Children and adults use math day-in and day-out when they estimate lengths and distances, move their bodies successfully in new environments, and notice differences in quantity. If one looks at math more academically, research shows that strong math abilities in early childhood are an indicator for later school success in both math AND reading. In Head Start, Mathematics is one of the areas on which to plan and assess preschooler's growth, and Number and Operations is a math area required by law on which to track preschool child outcomes.

### The Early Childhood Longitudinal Study

Research finds that the math knowledge children have when they enter kindergarten can have a significant impact on their later school success. The Early Childhood Longitudinal Study identified over 20,000 children at kindergarten entry and followed over half into elementary school. They found that children living in poverty were, on average, behind in their math knowledge at kindergarten entry compared to children from more economically advantaged families.

- ♦ **There is a significant math gap at kindergarten entry for low income children** (Denton & West, 2002)
- ♦ **Early math skills in kindergarten predicted 5th grade achievement in math and reading** (Claessens, Duncan, & Engel, 2006)

The bottom line is that *early math is critical*; children who **are** prepared have an advantage that carries far beyond the early years. Research also tells us that children reared in poverty are more likely to have smaller vocabularies than middle and upper class children (Hart and Risley, 1999). Head Start has the unique opportunity and responsibility to provide important math and key math vocabulary experiences to children and families to narrow this achievement gap.



*"In every early childhood setting, children should experience effective, research-based curriculum and teaching practices."*

- NCTM/NAEYC, 2002, p1

## Aims and Outcomes of the High Five Mathematize Guide

The Office of Head Start (OHS), along with the larger field of early childhood education, recognizes the importance of mathematics in the lives of young children and families. The OHS Math Webcasts, Early Head Start Math Tip Sheets, and other trainings and resources all show Head Start's commitment to early math education. This guide is another pathway to support Head Start and Early Head Start children's growth. It is written specifically to help education leaders in their role with teaching staff and home visitors by providing information about birth-to-five child development in mathematics and professional development resources.



This teacher is participating in a series of math professional development opportunities. This particular training includes hands-on learning, a focus on the child outcomes, and research-based math teaching strategies.

### High Five Mathematize Guide

#### The Guide will:

- ◆ Build on Early Head Start and Head Start educational leaders' knowledge of child development in mathematics
- ◆ Provide a strong research-base about early childhood mathematics
- ◆ Encourage a data-based decision making approach to mathematics education and professional development
- ◆ Supply professional development resources, tools, and approaches for education leaders to promote high quality math education

#### Readers and users of the Guide will:

- ◆ Increase and/or improve math professional development for teaching staff and home visitors
- ◆ Strive to use program data to steer decision making about math curriculum and family education
- ◆ Individualize professional development for teaching staffs' unique abilities and levels of experience



## Aims and Outcomes of the High Five Mathematize Guide

The intended audience for the High Five Mathematize Guide is Head Start and Early Head Start, early care and education leaders, trainers, and monitors. Head Start programs may, of course, share this information with their partners and other local education agencies.

The information in each of the High 5 Mathematize chapters about early childhood development in mathematics will be useful to all who work with children ages birth-to-five and their families. The monitoring, supervision, and professional development section of each chapter may be of most use to those in positions of leadership that require program planning, training, and professional development for teaching staff, home visitors, and families.



### **The Guide is for all education leaders**

- ◆ Directors
- ◆ Education Content Specialists
- ◆ Education Managers, Coordinators, and Supervisors
- ◆ Family and Community Partnership Managers
- ◆ Home Visitor and Prenatal Supervisors
- ◆ Family Education Coordinators
- ◆ Site Supervisors
- ◆ Training Coordinators
- ◆ Mentors and Mentor-coaches
- ◆ Master Teachers
- ◆ Ongoing Monitoring Staff

### **Other stakeholders can benefit from the Guide**

- ◆ State and Regional Training and Technical Assistance Providers
- ◆ State Collaboration Offices
- ◆ State Prekindergarten Partners
- ◆ Local Education Agencies

## Mathematize

The Guide uses and promotes the strategy of mathematizing. Mathematize means bringing out the math in what children are doing.

Adults—teaching staff, family members, child care providers, and home visitors—can mathematize children’s experiences by

- ♦ Emphasizing math concepts and relationships
- ♦ Using mathematical language
- ♦ Making comments, asking and answering questions, and posing problems
- ♦ Providing a variety of materials and tools with which to explore math ideas

*“From ages 3 through 6, children need many experiences that call on them to relate their knowledge to the vocabulary and conceptual frameworks of mathematics—in other words, to ‘mathematize’ what they intuitively grasp.”*

- NCTM/NAEYC, 2002, p6

Besides being fun and catchy, the High Five Mathematize chant (at right) introduces the math areas and gives examples of mathematizing.

The chant illustrates how everyday experiences like cooking relate to Number and Operations. Quilts, baskets, and music relate to Patterns, and so on. The final stanza of the chant talks about learning environments—“in class, at home or on the run”—and shows that math can happen anywhere...anytime.

Give the *High Five Mathematize!* chant a try. Read it aloud and the rhythm will come alive!

### High Five Mathematize!



High Five, High Five—Mathematize!  
To help our learning come alive.  
Five math strands make us aware,  
We can learn math anywhere!



Counting numbers—one, two, three.  
Math is fun for you and me.  
Two eggs, four eggs, six eggs, then;  
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Quilts and baskets, braided hair.  
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One block, two blocks, three blocks, four.  
Longer, shorter, bigger, small.  
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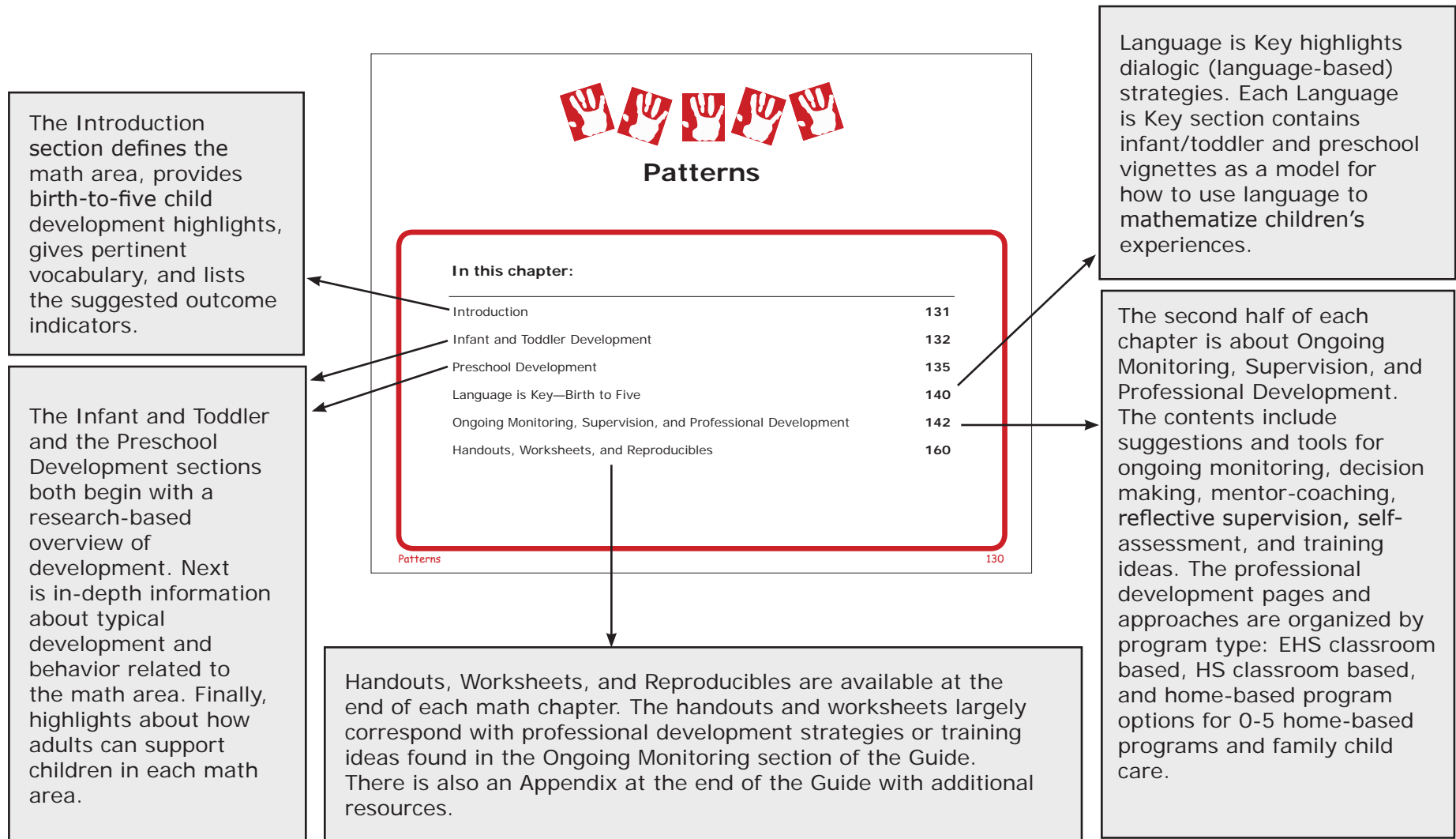


In class, at home or on the run,  
Learning environments are the thumb.  
A hand of math strands opens wide;  
The High Five chant will be our guide.

**High Five, High Five—Mathematize!**

# Chapter Contents

There are six chapters in the Guide; an introductory chapter, a chapter on individualization, and four that cover the math areas—Number and Operations, Geometry and Spatial Sense, Patterns, and Measurement. Each of the math chapters is similarly organized. The diorama below uses the Patterns table of contents to introduce the organization and content of each chapter. References can be found at the end of the Guide.



## Professional Development Planning

Teaching staff need knowledge of math, the ability to mathematize, and a positive attitude toward math to support young learners. Many competent and professional early childhood staff lack confidence in their math skills and/or have little training specific to math. Even supervisors may not be sure how best to support teaching staff and home visitors in teaching math.

Remember that there is no perfect supervisory or training style to use with teaching staff when supporting their continued learning. So, for staff with a wide range of expertise, try the following leadership techniques to strengthen professional development and outcomes for children in the area of mathematics.

Not only is it best practice to individualize for teaching staff, but the Head Start Act of 2007 requires all full-time, direct service staff to have professional development plans [Sec.648A(f)].



### Leadership is Critical

1. Make goals and expectations around math clear
2. Observe and monitor performance at the level appropriate for each staff person
3. Give feedback specific to math skills and math-curriculum implementation

Supervisors must choose techniques depending upon their role in the program, time constraints, and the level of knowledge and comfort of teaching staff. The following page offers some examples of what works best with teaching staff with different levels of knowledge, experience, and confidence. Challenge teachers and home visitors to become increasingly self-motivated and self-directed in accomplishing the program's math goals.



## Professional Development Planning

Providing math support for a wide variety of teaching staff means recognizing they all enter the early childhood profession with diverse educational qualifications. Professional development is a continuous cycle for education leaders first to know their staff, and then to respond to their strengths and needs. The information below can guide supervision and professional development decisions. The Ongoing Monitoring, Supervision, and Professional Development section within each chapter also has additional tools and information.

### **MATH BEGINNERS: Provide Direct Instruction**

Beginners feel supported by direct instruction when it is part of a long-term plan to increase math competence. They may have little knowledge of how to mathematize lesson plans or put them into practice. Assess individual needs and provide specific information in small segments to help beginners learn a few math tasks well. Use observations and constructive feedback to help them internalize math messages.

### **SOME MATH COMPETENCE: Use Coaching**

As staff develop some math competence, they feel supported by techniques such as mentoring, observations, giving suggestions, modeling, etc. Although coaches provide frequent direction, they also offer personal, individualized mentoring. The intensity of mentor-coaching and schedule limitations mean this phase lasts for a fairly short period of time.

### **MODERATE MATH COMPETENCE: Provide Support**

As staff gain competence and confidence, a supportive role works best. This is less focused on hands-on directing or coaching and more focused on staff's personal responsibility. Provide a clear message that staff are trusted to accomplish math tasks on their own, with ongoing encouragement, resources, and support.

### **HIGH MATH COMPETENCE: Let Them Shine**

Provide highly competent and motivated staff with math resources to use or modify, and challenging opportunities, like mentoring new staff, doing in-house trainings, or creating professional presentations.



Direct, hands-on support is appropriate for new teaching staff. It provides practical, step-by-step guidance.



## Mentor Coaching and Reflective Supervision

The Head Start Act of 1998 included guidance about mentoring and mentor-teachers. In response to the guidance, OHS introduced *Steps to Success: Early Literacy Mentor-Coaching Curriculum* (2005), a comprehensive resource designed to train mentor-coaches. The *Steps to Success* box set includes facilitator and mentor-coach manuals, a Protégé Journal, Decision Maker's Guide, and DVDs to accompany and illustrate many of the concepts within the manuals.

The Guide was developed as a math content companion to the literacy-focused *Steps to Success*. The Guide references many of the excellent resources in the *Steps to Success* curriculum. Look for mentor-coaching and reflective supervision suggestions in the Ongoing Monitoring, Supervision, and Professional Development section of each chapter. Reflective supervision, like mentor-coaching, is an interactive supervisory approach and is included in the *Steps to Success* materials. Additional resources about *Steps to Success* and reflective supervision are available on the Early Childhood Learning and Knowledge Center (ECLKC) website at <http://eclkc.ohs.acf.hhs.gov>.



***“Mentoring is ideally suited to the Head Start philosophy and approach to staff development.”***

**- HHS/ACYF/OHS, 2001, p3**

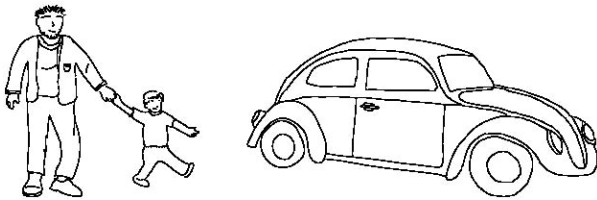
- ◆ The Head Start Performance Standards require a formalized approach to training and professional development
- ◆ Mentoring reflects the principles of adult learning that guide Head Start professional training
- ◆ Mentoring is a strategy to ensure the implementation of curricula and best practices in teaching and home visiting
- ◆ Mentoring encourages reflective practice
- ◆ Mentoring supports and recognizes experienced staff for their expertise
- ◆ Mentoring fits with Head Start’s policy of individualizing to meet the needs of children and families
- ◆ Mentoring reflects the philosophy of the partnership building characteristic of Head Start programs

## Introducing Language is Key—Birth to Five

Each math chapter contains a section called Language is Key—Follow the CAR. Follow the CAR is a set of strategies from which to choose in order to extend conversations with children. It highlights research-based, dialogic strategies promoted by Head Start and the National Head Start Family Literacy Center. They are important language and concept development strategies for teaching staff, home visitors, and families to know and use. Dialogic strategies can be used to mathematize any activity in which adults interact with children. Conversations, playing, riding in the car, going to the grocery store, sharing and reading books, and daily routines are all opportunities to use the approaches. The acronym—Follow the CAR—is an easy way to remember to use dialogic strategies (StoryQuest, 2004).



### Follow the CAR



#### Follow the child's lead and then:

- ⇒ Comment and wait, or
- ⇒ Ask question and wait, or
- ⇒ Respond by adding a little more and wait, or
- ⇒ When speaking in the home language and a child says a word in English, repeat the word in the home language

*Language Is the Key—Follow the CAR* is a multimedia resource distributed by the National Head Start Family Literacy Center. If your program does not have the book and DVD already, email [info@wlearning.com](mailto:info@wlearning.com).

### Research Bites About Dialogic Strategies

- ◆ The strategies work with children from birth to eight years, who use one or more languages, those from diverse cultures, as well as children with disabilities (Valdez-Menchaca, et al., 1992; Fuller-Collins, 2005; Roberts, 2008; Lim & Cole, 2002)
- ◆ When used correctly by teaching staff and families together, these strategies resulted in significant improvement in language skills in as little as eight weeks (Whitehurst, et al., 1994; Lonigan & Whitehurst, 1998)
- ◆ Children talked more, developed more complex, sophisticated vocabularies, and took part in more language experiences such as turn-taking (Lim & Cole, 2002)



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## Introducing Language is Key—Follow the CAR

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### Follow the CAR or Sigue el CARRO

**Follow the child's lead.** When adults focus on children's interests, children engage more readily and successfully. This is the key to using the following dialogic strategies. Encourage staff to let infants, toddlers, and preschoolers choose books, activities, and experiences that interest them.

**Comment and wait.** Comment about what children point to, look at, or do. For example, a toddler holds a foam shape toward the teacher, who comments, "It's a cube." Then she pauses, waiting at least five seconds to give the child a chance to think about the comment and respond. When adults add lots of comments at once, they end up taking over the conversation. Research shows simply commenting and then attentively waiting is the hardest strategy for adults to use (StoryQuest, 2004), but with practice it is doable.

**Ask questions and wait.** Adults need to remember children require at least five seconds of wait time to listen to questions, think about what they mean, and determine answers before they can respond. Some children need more than five seconds. Help teachers, home visitors, and families think about the type of questions (open and closed ended) they ask. Make sure to follow the child's lead and ask challenging questions that are not too hard for the child to answer.

### Respond by adding a little more and wait.

The adult responds to something the child has just said. It keeps the conversation going, builds children's language, and helps children develop their listening skills. It is the adult's job to match their responses to each child's developmental level. Here is an example of a good developmental match. The toddler says, "Two car!" The adult responds, "Yes. Two little cars."

### Repetir Otra Vez (repeat again in the home language)

This strategy only applies to dual language contexts. During a conversation between an adult and child in the home or heritage language, children may "code-switch", or say a word or phrase in English instead of the home language. The adult simply repeats the word or phrase in the home language and continues with the conversation.





## Notes





# Individualizing to Meet the Needs of All Children





# Individualizing to Meet the Needs of All Children

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## Introduction to Individualization

The information in this chapter concerns individualization, also known as differentiated instruction. Individualization should be a frame or lens through which to view the chapters on Number and Operations, Geometry and Spatial Sense, Patterns, and Measurement.

Individualization is a vital practice and requires individualized planning for each child's strengths and needs. Child development and early childhood education should:

- ♦ Be developmentally and linguistically appropriate, recognizing that children have individual rates of development as well as individual interests, temperaments, languages, cultural backgrounds, and learning styles;
- ♦ Be inclusive of children with disabilities, consistent with their Individualized Family Service Plan (IFSP) or Individualized Education Program (IEP); and
- ♦ Provide an environment of acceptance that supports and respects gender, culture, language, ethnicity, and family composition.



*"The critical point is that the focus of an activity—the essence of the experience—is defined not by the whim of the staff, but through careful observation of each individual child and knowledge of the developmental progression: what is the next step for this child on the path to achieving positive outcomes."*

- The Head Start Leaders Guide to Positive Child Outcomes, 2003, p112

## Introduction to Individualization

During the course of each family's participation in Head Start or Early Head Start, teaching staff and home visitors—with the support of supervisors and specialists—make planning decisions to meet children's needs. Decisions are guided by Head Start Performance Standards, child outcomes indicators, Individual Education Plans and Individual Family Service Plans, and best practices in the field of early childhood education. Individualization can be thought of as a decision-making cycle where "ongoing observation and assessment" and "planning and implementation" inform one another.

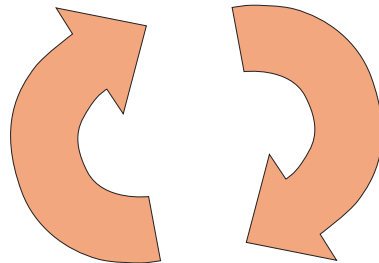


*"Well-conceived, well-implemented, continuous assessment is an indispensable tool in facilitating all children's engagement and success in mathematics."*

- NAEYC/NCTM, 2002, p13



### Ongoing Observation and Assessment



### Planning and Implementation

## Individualization Cycle

### Ongoing Observation and Assessment

Teaching staff and home visitors, with the help of families, make observations and do periodic formal assessments as well as ongoing *informal* assessments. It's a process that keeps staff and families up-to-date on each child's growth, development, and needs. It also helps answer the question, "*What is the next step for this child on the path to achieving positive outcomes?*"

### Planning and Implementation

After considering observation and assessment information on each child, teaching staff plan and implement so the learning environment, one-on-one time, small group, and large group experiences meet the needs of every child and foster a home-school connection.



## Meeting the Needs of Children with Disabilities

Head Start and Early Head Start staff, families, and community agencies work together to provide services and specialized care to infants and toddlers with Individualized Family Service Plans (IFSPs), and to preschoolers with Individualized Education Plans (IEPs). All children are entitled to the full range of services and educational opportunities. With thoughtful planning and adaptive strategies every child can enjoy and learn math.

### Adapt the Environment or Experiences So All Children Have Access and Can Participate

- ◆ Use large manipulatives that are easier for some children to grasp and see
- ◆ Put Velcro on blocks to help them stack
- ◆ Work with a child's physical or occupational therapist to incorporate appropriate spatial sense activities
- ◆ When helping a child with visual or mobility challenges move from one area to another, use math words; for example, discuss how far they have to go, how high they have to step, or how many steps it takes to get there
- ◆ Allow more time and increased opportunities to practice activities
- ◆ Explicitly encourage families to maximize the math learning opportunities that occur in their daily routines



## Meeting the Needs of Children with Disabilities

### Strategies that Support Individualization\*

**Environmental Support**—Adapt the physical or social environment or the timing of activities to allow a child to fully participate, engage, and learn

**Materials Modification**—Modify materials so the child can participate as independently as possible

**Modifying the Activity**—Simplify a complicated task by breaking it into smaller parts or reducing the number of steps

**Using Child Preferences**—Identify and integrate the child's preferences so the child looks forward to using materials and participating in activities

**Peer Support**—Encourage dyads or small groups that include children with and without disabilities to increase a child's participation

**Adult Support**—Join in the activity to support the child and allow him or her to participate more fully

\*Adapted from *The Head Start Leaders Guide to Positive Child Outcomes (2003)*.

*"Quality instruction in early mathematics is particularly critical for children with disabilities."*

- Notari-Syverson & Sadler, 2008, p2



### Individualizing takes practice...



Try modifying the Hula Hoop Game featured on the OHS Math Webcast #1. Consider ways to modify the game so every child can participate. Could children and teaching staff

- ♦ Play outdoors?
- ♦ Play in a smaller space?
- ♦ Use different objects or materials?
- ♦ Represent results in a different way?
- ♦ Make the game simpler?
- ♦ Make the game more complex (mathematically or physically)?
- ♦ Work with a buddy or on a team?

## Meeting the Needs of Dual Language Learners

The Head Start Family and Child Experiences Study (FACES) report shows that over one quarter of children enter Head Start and Early Head Start from homes where English is not the primary language (HHS/ACYF, 2008). With the aim of meeting all children's needs, staff need information and support to address the unique abilities of dual language learners entering their programs.

Research shows that children with a strong background in their first language learn a second language more easily and have cognitive, academic, and personal/cultural advantages (Ada & Zubizarreta, 2001; Collier, 1987; Cummins, 1984). Head Start staff and families working together can enhance children's potential and help them attain the benefits of being multilingual.

### A Comprehensive Language Policy Will Support Children, Families, and Staff

- ◆ Develop a language policy that involves the entire Head Start community
- ◆ Specifically address how first and second language development and content areas, such as math, will be assessed
- ◆ Help staff integrate the language policy and procedures into their written plans and interactions with children and families
- ◆ Team with families to help them teach their children math concepts in conversations, play, and in the course of daily routines



*"The language we speak is instrumental in forming our identity."*

- Bialystock, 2001, p5



## Meeting the Needs of Dual Language Learners

Learning a first or second language means learning to communicate by listening, speaking, reading, and writing. When it comes to content-area language and vocabulary, like mathematics, children need support in both languages, in order to become truly bilingual. Novice and veteran teaching staff alike can benefit from a review of strategies and best practices that support dual language learners. Many resources are available on the ECLKC website, including the following publications: *Head Start Bulletin #78 English Language Learners* (HHS/ACYF/OHS, 2005), *Bilingual Infant/Toddler Environments: Supporting Language and Learning in Our Youngest Children* (Stechuk, Burns, & Yandian, 2006) and *Making A Difference: A Framework for Supporting First and Second Language Development in Preschool Children of Migrant Farm Workers* (Stechuk, 2005).

### **Strategies to Scaffold Young Dual Language Learners' Mathematical Development** (Weaver & Gains, 1999; Tabors, 1997)

- ♦ Respect the silent period (allow children time to listen and to decide when they are ready to speak English)
- ♦ Modify language (use short, concise sentences and in-context vocabulary)
- ♦ Use manipulatives and everyday objects (show examples of what math concept is being discussed)
- ♦ Use modeling and acting out (gesture and mime to show children what to do)
- ♦ Use oral descriptions (frequent conversations full of math-rich language)
- ♦ Match questions to the child's proficiency in English
- ♦ Maintain a daily schedule so activities and routines are predictable and familiar
- ♦ Talk with and guide English-speaking children in the classrooms to become language partners for dual language learners
- ♦ Use curricular modifications (e.g., small-groups, safe havens, engaging book-reading, cooperative games) to help dual language learners feel more comfortable, included, and competent



## Meeting the Needs of Children from All Cultures

There is no magic way to teach “multicultural math” or any other area. The magic is in the diverse experiences and perspectives that families, children, and staff bring to Early Head Start and Head Start programs. “Building trusting relationships, being sensitive to families’ cultural preferences, building bridges between cultures, and supporting true partnerships between staff and parents are the four keys to supporting cultural diversity” (OHS/ACYF/HSB, 2004). When staff talk with families and use the cultural knowledge gained from those conversations to guide their lesson plans and practices with children, they are being culturally sensitive and providing culturally consistent early education and care (Steps to Success, Unit 1, Module 2, pM-8, 2006).

Head Start and Early Head Start programs provide an environment of acceptance that supports and respects gender, culture, language, ethnicity, and family composition. All interactions with families should be respectful of diversity, cultural and ethnic background.



### Approaches to Foster Development of Linguistically and Culturally Diverse Learners\*

- ◆ Connect family knowledge, particularly supporting oral traditions in native populations
- ◆ Encourage relationships between children and significant adults, recognizing that intergenerational connections are important to the wellbeing of children
- ◆ Acknowledge links to history, thought, emotions, and practices still relevant today
- ◆ Encourage spiritual grounding
- ◆ Foster connections to community participation and history
- ◆ Develop or honor a unique worldview
- ◆ Open pathways that allow all children to be successful in many ways

\*Adapted from TA Paper No. 12 *Honoring Cultural Traditions: Early Head Start Programs in American Indian and Alaska Native Communities* (EHSNRC, 2008, p6).

## Meeting the Needs of Children from All Cultures

Every child comes to Head Start with a diverse and rich family culture. Read more about the Office of Head Start's commitment to diversity in enrollment, program design, and services in the *Revisiting and Updating the Multicultural Principles for Head Start Programs Serving Children Ages Birth to Five* (HHS/ACF/OHS, 2010).

### Principles Supporting the Framework for Multicultural Programming in Head Start

1. Every individual is rooted in culture.
2. The cultural groups represented in the communities and families of each Head Start program are the primary sources for culturally relevant programming.
3. Culturally relevant and diverse programming requires learning accurate information about the culture of different groups and discarding stereotypes.
4. Addressing cultural relevance in making curriculum choices and adaptations is a necessary, developmentally appropriate practice.
5. Every individual has the right to maintain his or her own identity while acquiring the skills required to function in our diverse society.
6. Effective programs for children who speak languages other than English require continued development of the first language while the acquisition of English is facilitated.
7. Culturally relevant programming requires staff who both reflect and are responsive to the community and families served.
8. Multicultural programming for children enables children to develop an awareness of, respect for, and appreciation of individual cultural differences.
9. Culturally relevant and diverse programming examines and challenges institutional and personal biases.
10. Culturally relevant and diverse programming and practices are incorporated in all systems and services and are beneficial to all adults and children.



## Notes









# Number and Operations

*Counting numbers-one, two, three.*

*Math is fun for you and me.*

*Two eggs, four eggs, six eggs, then;*

*Enough for an omelet to feed our friends.*





# Number and Operations

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## Introduction

This chapter discusses infants', toddlers', and preschoolers' learning about number and operations and how adults can support learning in the classroom and at home. Early number development includes learning the words for numbers (including the counting series), understanding that a number word refers to a particular quantity, learning how to count objects, comparing and ordering quantities, and recognizing and understanding the meaning of numerical symbols. Young children also begin to learn about number operations—how groups of objects can be put together or taken apart to create larger or smaller groups. Adding, taking away, multiplying, and dividing are common number operations.

The first years of a child's life are filled with many experiences related to quantity. Experiences noticing and exploring quantities in infancy are foundational to learning about numbers. During the toddler years, children learn concepts such as "more than" and "less than", and they begin to count. In preschool, children's counting skills improve as they count small groups and label them with numbers, compare groups of objects to determine which has more, and share evenly with friends. The conceptual development and skill building during the birth-to-five years are important for number and operations success in elementary school and beyond.



### Number & Operation Terms

- ◆ Subitizing
- ◆ One-to-One Correspondence
- ◆ Counting Objects
- ◆ Cardinality
- ◆ Counting Sequence
- ◆ Combining & Separating

*See Appendix for complete Glossary.*

### Number and Operations Indicators

- ◆ Demonstrates increasing interest and awareness of numbers and counting as a means for solving problems and determining quantity
- ◆ Begins to associate number concepts, vocabulary, quantities, and written numerals in meaningful ways
- ◆ Develops increasing ability to count in sequence to 10 and beyond
- ◆ Begins to make use of one-to-one correspondence in counting objects and matching groups of objects
- ◆ Begins to use language to compare numbers of objects with terms such as more, less, greater than, fewer, equal to
- ◆ Develops increased abilities to combine, separate, and name "how many" concrete objects



## Infant and Toddler Development

This section focuses on infants' and toddlers' development of number and operations. First, read about the developmental highlights for infants and toddlers. Then, consider the ways in which teaching staff, home providers, and families can support learning in this area.



*"Young children's earliest reasoning is likely to be about number situations, and their first mathematical representation will probably be of numbers."*

- NCTM , 2000, p32

Infants appear to have a natural sensitivity to number. Even newborns can discriminate differences between groups of two objects and three objects (Antell & Keating, 1983). Some of children's earliest words, such as "more" and "all gone", refer to quantity. Children begin to use number words very early, especially "two" (Wagner & Walters, 1982). Toddlers may be heard reciting counting words, "one, two, three," and learn to hold up two fingers to show how old they are. As they grow, number knowledge develops through children's interactions with the people and the world around them.

### Infants and Toddlers:

- ◆ Discriminate differences of one between very small groups of objects, such as 1 versus 2 and 2 versus 3 (e.g., Antell & Keating, 1983; Starkey & Cooper, 1980; Strauss & Curtis, 1981), and larger differences between larger groups, such as 8 versus 16 (Xu & Spelke, 2000)
- ◆ Organize objects into groups and change amounts by adding or removing objects (e.g., Langer, et al., 2003)
- ◆ Understand that adding makes more and taking away makes less (Sophian & Adams, 1987; Starkey, 1992)
- ◆ Begin to understand and use words that refer to quantity, including number words
- ◆ Begin to accurately label small groups of objects, first two objects then one and three
- ◆ Begin to learn the counting sequence, and may try to count groups of objects by pointing and saying number words (Wagner & Walters, 1982)

## Knowing How Many—The Role of Very Small Numbers

Infants and toddlers are sensitive to small numbers. This sensitivity is important to children’s earliest number skills and knowing “how many”.

### For example:

- ♦ They notice amounts—large and small—and even notice when amounts change, so long as it’s obvious by looking
- ♦ Young children’s first understanding of exact number is with very small numbers, like giving a sibling exactly two crackers when asked for two
- ♦ They first accurately label quantities of very small groups—two is first

When children (and adults) recognize instantly, without counting, how many objects are in a small group, it is called **subitizing**. Adults do not need to teach subitizing, beyond helping children learn the number words. Toddlers will make the connection between the quantity two and the number word “two” with repeated exposure.

## Learning to Count

Learning how to count is an important skill that develops gradually in early childhood. As infants hear number words used to refer to groups of things, they begin to register their meaning. Toddlers begin using number words to label quantities, though they may not use them accurately. They may also try to count objects by pointing and saying the number words they know. Infants and toddlers must be exposed to the counting words many times before they begin to repeat them. Learning to count takes time, practice, and adults (or older children) modeling the language.

### For example, infants and toddlers:

- ♦ Say the numbers, “One, two, three!” before jumping or being picked up
- ♦ Carefully repeat the first few numbers in the counting sequence as they walk up stairs, then skip numbers and say “ten!” when they reach the top
- ♦ Begin to use the number word “two” when asked how old they are and may even hold up two fingers to represent the number
- ♦ Toddlers begin to say the counting sequence while pointing to objects in a collection, often miscounting by skipping numbers or making one-to-one correspondence errors (Wagner & Walters, 1982)



By 24 months of age, many toddlers have learned their first number word, typically “two”.



## Comparing and Ordering Quantities

The ability to compare quantities and determine if they are equal or which has more or less is an important dimension of young children's developing number knowledge. Children can first compare and order amounts of things that are obviously the same or different, that is, if groups are very small or the difference between them is very large. Later, they learn strategies for comparing such as matching (putting objects in one-to-one correspondence) and counting.

In their play, infants put objects together into groups and change the groups to make them larger or smaller. They also notice larger versus smaller amounts. For example, a child who loves raisins might be excited to see lots of raisins in her snack bowl.

Toddlers put things together in one-to-one correspondence based on how they go together, but not usually to compare number. However, they can determine which of two groups of objects has more as long as the groups look very different in number, and they use words such as "a lot" and "many" to refer to large groups. They also begin to use comparison language, saying, for example, "I have more."

### For example:

- ♦ Infants, when given two piles of cereal, tend to choose the pile that appears to have more
- ♦ An older infant plays with a collection of farm animals, moving them around on a table and creating different size groups
- ♦ A 21-month-old, asked to get dog treats for their two dogs, goes into the kitchen and brings back two dog bones, exactly one for each pet (Mix, 2002)
- ♦ Toddlers match objects like small and large counting bears to make "mommy and baby" pairs



These older toddlers explore one-to-one correspondence by placing, or matching, one peg with one hole.

## Operations: Addition and Take Away

Infants begin to build concepts about adding and taking away in their play with objects. They put objects together into groups and change the groups by adding and removing objects. Early experiences seeing how amount and number are changed by adding and taking away help older infants and toddlers develop a basic understanding that adding objects to a group makes more and taking objects away makes less (Mix et al., 2002; Starkey, 1992).

Toddlers are increasingly aware of and interested in number and amount. They purposefully manipulate amounts of things, adding and taking away objects to make more or fewer. Experiences manipulating very small numbers of objects (up to three) are particularly important since children can readily see how the number of objects has changed (Baroody & Wilkins, 1999).

As children are learning to add and subtract accurately, they are first able to do this successfully with a very small number of objects. Playtime and mealtimes provide everyday experiences and interactions that support this understanding.

### For example:

- Infants enjoy repeatedly putting objects in containers and then taking some or all of them out
- Older infants and toddlers enjoy adding and taking away objects one at a time, for example, putting several rings on a stacking cone and then removing and replacing them, one-by-one, over and over again
- Infants notice they have eaten all their snack and quickly learn that gesturing or signing for “more” can result in another pile of cereal
- Toddlers notice when a friend has more of something, such as a snack or set of toys, and might say, “I want more!”
- Toddlers put groups of objects together, like crayons, and begin to share (or take away objects) by giving a crayon to an adult or friend





## Adult Support for Infant and Toddler Development of Number and Operations Concepts



### Materials, Environments, and Experiences

Infants and toddlers build early concepts about number and operations as they explore quantities in their play. Teaching staff, parents, and home visitors facilitate children's early number development by ensuring opportunities to explore and learn and by providing the language of number. It is important that adult caregivers emphasize number concepts by using number words and comparison words (more, less, same) in contexts that are meaningful.

#### For example, adults can:

- ◆ Provide a variety of hands-on, concrete opportunities for children to explore collections of interesting materials like blocks, plush toys, and other easy-to-grasp objects
- ◆ Discuss who has more or less of something
- ◆ Use number words (one, two, or three) to label very small groups of objects; for example, "I'm giving you more crackers. Now you have three!"
- ◆ Find opportunities to count with children, such as counting steps while walking outside or up and down stairs
- ◆ Model counting strategies, like touching objects one-by-one as they're counted or narrating for the children when counting together

### Parent Groups

Help parents consider the many ways they can talk with children about number and quantity. Use a flip chart to brainstorm situations where they see children combine and separate (add to and take away from) a group of objects.

- Putting blocks in a pile or connecting Legos are examples of adding
- Adding 4 more grapes to your child's plate is an example of combining
- Removing 5 toys from the bathtub is an example of separating (take away)
- Taking 2 blocks off the top of a block structure is also an example of separating or subtraction

### Number and Operations Vocabulary and Phrases

Count	Share	One, Two, Three, Four, Five	How many?
One more	First, Second, Last	A lot	Altogether
One less	Same as	A few	Add/Take away



## Adult Support for Infant and Toddler Development of Number and Operations Concepts



*Look for and listen to Number and Operations experiences and interactions in Early Head Start Programs*



Infant/Toddler Center-Based Classrooms and Family Child Care Homes	Home-Based Option Family Settings
As Dulce lies on her stomach, she gazes at a toy, reaches for it, and pulls it toward herself. Then she reaches toward a second toy.	After an active game, twins Charise and Shawnte hug each other and slowly count to 10 to calm down before starting a quiet experience.
While playing outside, Teacher counts out loud as she pushes Atiyah on the swing. With each push, she counts, "One, two, three..." Atiyah repeats each number after the teacher.	The home visitor brings a chart of information about child development to share with the family. It explains that infants are already learning about number. Baby Ashton holds a teething ring in each hand and the home visitor says, "Oh, you've got two rings!"
Xavier drops one beanbag into a plastic bucket, and then a second and third one. The teacher helps him spill them back out. Xavier drops them in again.	Baby Gita's mom tells the home visitor that she's started a ritual of counting Gita's toes or fingers after changing her diaper. The older siblings have started joining in.
Teacher shows Mary two piles of her favorite crackers. One pile has one cracker. The other pile has three crackers. Mary reaches for the pile with three crackers.	After Mimi brushes her teeth, the "Getting into Bed" game begins. Her mother slowly counts. Mimi tries to get under the covers before her mother counts very high.
The older infants delight in the song "One Potato, Two Potato" and always want to do it again. Teacher chants the song and helps the infants bump their fists or feet together to the beat.	The home visitor and toddler Isabel put all the farm animals onto the blanket and take them off, over and over again. The home visitor says "one more" or "one less" for each time Isabel adds or takes away an animal.



## Preschool Development

This section focuses on preschoolers' development of number and operation knowledge. First, take a look at how preschoolers develop understanding of different number concepts. Then, consider ways in which teaching staff, home providers, and parents can support learning in this area.

Preschoolers are naturally interested in numbers and finding out “how much” and “how many”. They learn to use their developing number skills to compare who has more toys or to find out how many raisins are in their snack boxes. They begin to learn that number symbols can represent many different quantities, such as how many blocks they have, how old they are, or what day of the month it is. With concrete objects and in everyday contexts, children begin to answer “plus one” and “minus one” number problems. While preschoolers work on mastering small numbers, they also enjoy big numbers, though they might not say them correctly (e.g., “I think I have about eighty-twenty.”).

### Preschoolers:

- ♦ Begin to recite the counting sequence to 10
- ♦ Are interested in counting as high as they can—to “really big” numbers—and are getting better at reciting numbers between 10 and 20
- ♦ Count different collections of objects and understand the last number spoken represents how many are in the group (Fuson, 1988; Gelman & Gallistel, 1978)
- ♦ Use a variety of strategies to compare quantities (e.g., visually comparing, matching one-to-one, and counting)
- ♦ Can identify up to 3 or 4 items in a collection without counting each item individually (Fischer, 1992; Starkey & Cooper, 1995)
- ♦ Begin to solve simple addition and subtraction problems with concrete objects
- ♦ Begin to recognize and write numerals such as their age or how many family members they have



## Knowing How Many— The Role of Very Small Numbers

Young preschoolers can typically use the number words one, two, and three to identify very small quantities without counting them. The ability to look at a small group of objects and automatically know how many there are is called subitizing. Preschoolers become very good at doing this with groups of up to about four objects.

### **With very small groups of objects, like 3 or 4, preschoolers can:**

- ◆ Know “how many” without counting
- ◆ Make a new group with the same number of objects by looking at another group (up to 3 or 4 objects)
- ◆ Determine which of two collections has more or less
- ◆ Add or subtract objects and see the exact effect on the total number of objects

Experiences using and exploring small numbers have a very important role in preschoolers developing number concepts. As evident in the list above, children’s abilities with small numbers are related to other developing number concepts like cardinality, more and less, parts and wholes, and adding and subtracting, all of which are building blocks for future learning.

In addition to subitizing small groups, preschoolers are also learning to use their counting skills to find out how many. Additionally, they may be learning to quickly identify the number in larger groups that are organized in familiar patterns, such as on dominos, dice, or playing cards. This skill is related to subitizing but is different because the patterns must be learned.

### **The Home-Based Program Option**

Counting is a math skill families commonly teach their children. Often they focus on memorizing the counting sequences. Instead of simple rote counting, encourage parents to use friendly questions and statements to encourage children to explore “how many”. For example:

- ◆ Can you give grandma two crackers?
- ◆ How many blocks do you have? Let’s count.

At the next group socialization, show a few photos of children at home or at school. Have participants brainstorm different “how many” questions related to the photo. Type the questions and provide the list to all families on the next home visit.



## Learning to Count

Learning to count is more than just learning to recite the number sequence. Children need experiences and support counting real objects. Once they learn to count even a small number of objects accurately, they can begin to apply this knowledge to real life situations—finding out how many and solving simple number problems.

When children start learning the counting sequence they often skip numbers or say numbers out of order. The first 10 numbers can only be learned by committing them to memory—much like the ABC's. When children first learn to count, they may not understand that the words represent *individual* numbers. It may sound more like one, long strand, onetwothreefourfivesixseven (Sarama & Clements, 2009; Fuson, et al., 1982). With experience, preschoolers make great strides in learning the important skill of counting.

### Preschoolers:

- ♦ By 3½ to 4½ years of age, have learned to count to 10 and begin to count to 20 or higher (Fuson, 1988)
- ♦ Find counting beyond 20 to be easier once they learn the counting pattern in the decades (20, 21, 22, 23...29, 30, 31, 32, 33...39, 40, 41, 42, 43...)

Eventually, as children learn to use numbers in relation to objects, the number sequence becomes meaningful, and more accurate, because it has a purpose—to answer the question, “How many?”

## Counting

### Young preschoolers:

- ♦ Are learning to verbally count to 10 and beyond
- ♦ Are beginning to correctly tag objects and assign only one number to each item
- ♦ Can correctly count small groups of 3 or 4 objects, but may not understand the last number word represents “how many”

### Older preschoolers:

- ♦ Increase accuracy counting small groups of objects and can identify “how many” are in the group after counting
- ♦ Begin to verbally count to 20 and beyond
- ♦ Are able to count out a smaller group of objects from a larger group (e.g., taking 5 crackers out of the snack basket)





## Learning to Count, continued

### To count objects accurately, preschoolers need to:

- ◆ Know the counting/number word sequence
- ◆ Tag each object once and label it with a number word (one-to-one correspondence)
- ◆ Keep track of the objects they have counted
- ◆ Know that the last number counted is the total number of objects in the group (cardinal principle)

When children are first learning to count objects, they often have trouble coordinating their actions (tagging each object) and words (saying the appropriate number in the counting sequence). They may skip or double count objects. Generally, the larger the number of objects, the more likely they are to make mistakes. Also, the less organized the group, the more difficulty they tend to have keeping track of what they have counted and what they have yet to count.

Preschoolers counting accuracy improves with lots of practice counting small groups of objects and moving gradually to larger groups.

It is also important to understand what number words mean. Young children may think that pointing to an object and saying “one” applies a label or a name for that object (Ginsburg, 2008). With experience, children begin to understand that number words can represent “how many”.

In counting groups of objects, this means knowing that the last number counted gives the total number of objects in the group (cardinality). This knowledge is also demonstrated when children can produce (count out) a given number of objects; for example, bringing six napkins to the snack table when requested.



### Cardinality

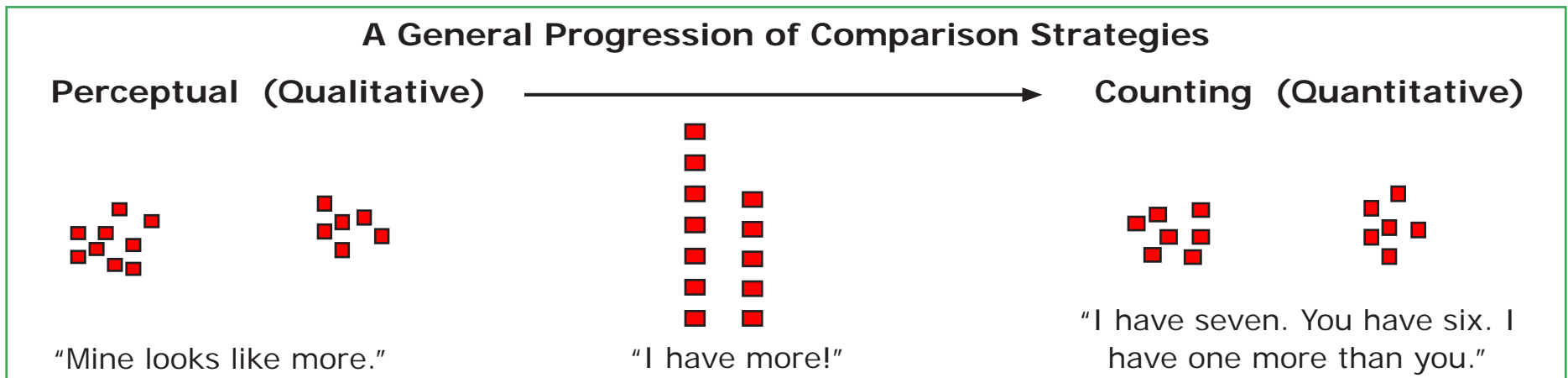
An important part of counting objects is understanding the principle of cardinality. Cardinal numbers answer the question “how many?” Before preschoolers understand this concept, they might count a group of objects and when asked “how many” they might recount the objects, or continue counting until they get to “ten” regardless of how many are actually in the collection. Once they understand the concept of cardinality, children can tell you the last number they said is the total number of items in the group.

## Comparing and Ordering Quantities

Preschoolers' strategies for comparing the numbers of objects in two or more groups develop gradually over time, along with other related number skills and concepts such as counting. Young children first compare numbers perceptually, generally by looking. This works very well with very small groups or when differences are large enough to be readily seen. In other situations, children need a different strategy to make accurate comparisons. Preschoolers learn to match groups by lining up objects in one-to-one correspondence to compare them. They also begin to learn to count and compare the number of objects in each group. However, they may not trust the results of their counting if it contradicts their perception. For example, a child may believe that a longer line of raisins has more than a shorter line, even though they're the same. Even older preschoolers are often distracted by perceptual cues, though they may be learning that moving objects around does not change their number (Piaget, 1952; Sophian, 2007).

### Preschoolers:

- Use perceptual strategies to compare groups that are very small or very different in number (e.g., can readily tell that a group of 20 is more than a group of 8)
- Have difficulty determining which group has more if a smaller group appears to take up more space than another, even when they have counted the groups
- Begin to directly compare two groups using one-to-one correspondence (like the middle example in the box below)
- Can count to compare two groups and determine if they have the same number or, if not, which has more
- Begin to use number to represent, describe, and compare groups of objects (e.g., five is more than three)



## Operations: Add, Subtract, Multiply, Divide

Combining and separating refer to simple number operations. Combining and separating involves adding, subtracting, multiplying or dividing objects. Sharing marbles equally with three friends is an example of division. In the preschool years, children's understanding of operations develops beyond simple labels of "more" and "less", becoming more quantitative and precise. With experience and guidance from adults, preschool children learn to use their developing skills to solve a variety of everyday number problems.

### For example, preschoolers:

- ◆ Answer questions about adding to groups of objects such as, "How many would you have if I gave you one more?"
- ◆ Learn to share or evenly divide sets with a friend
- ◆ Can figure out "how many more" to arrive at a certain number (e.g., "I have three graham crackers but there are four friends, so I need one more!")

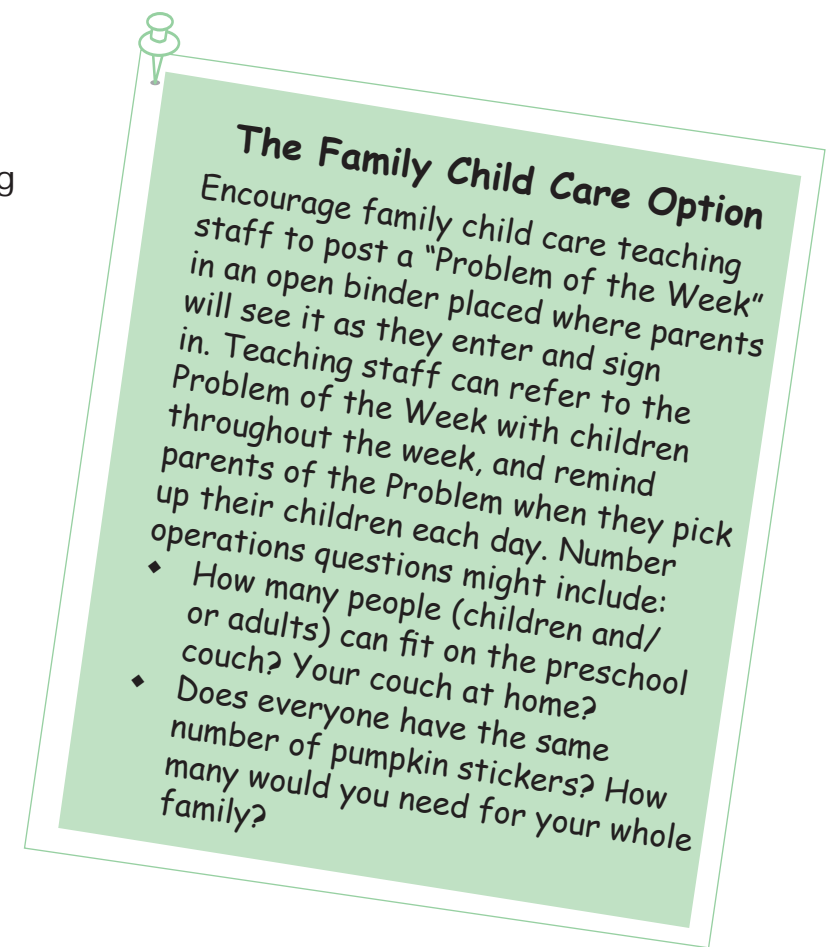
The research on simple adding and subtracting finds that both the size of the problem and how the problem is presented affect children's performance (Baroody, 2004; Ginsburg & Russell, 1981; Huttenlocher, et al., 1994; Hughes, 1986; Siegler & Robinson, 1982).

### Number operation problems that are easier:

- ◆ Use smaller numbers (up to five)
- ◆ Add or subtract only one object at a time
- ◆ Use concrete objects, like teddy bear counters

### Problems that are more difficult:

- ◆ Use larger numbers (more than five)
- ◆ Add or subtract more than one object at a time
- ◆ Are verbal and do not use objects







## Representing Number

In the preschool years, children learn that numbers can be represented in different ways:

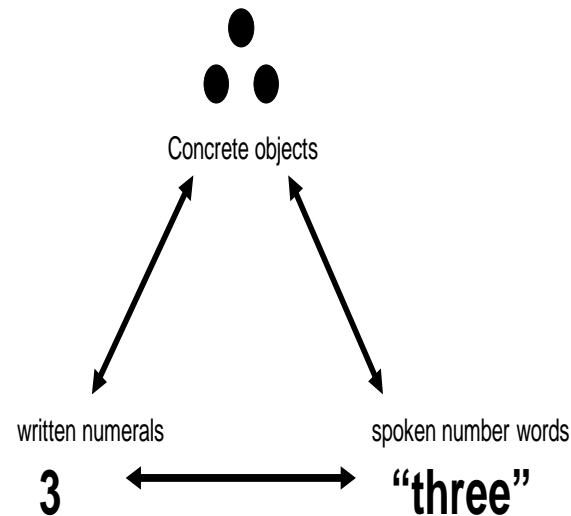
- ◆ Concrete objects
- ◆ Spoken words
- ◆ Symbols, like dots or hash marks (IIII)
- ◆ Written numerals

Representing quantity is a complex skill because numbers can be used to represent so many different things (e.g., age, height, how many spaces to move on a game board, or how many cups of flour to put in a recipe). While some preschoolers may look at the numeral “4” and say “four” this is not proof that they understand what that symbol and spoken word truly represent. This is similar to the ability to identify letters, but not understanding the sounds a letter makes. Learning to connect concrete objects with written numerals and number words is an ability that develops slowly with adult support and hands-on experiences.

## Representing Quantity

Children learn the spoken number “three” when they hear it from adults in reference to quantities of things and in the counting sequence. They begin to connect the spoken number words to concrete objects. Later, children learn that the written numeral “3” is a symbol for the spoken word “three”. Finally, after many years of exposure and experiences children understand the connection between the written numeral, the number words, and the quantity of a group of concrete objects.

- Adapted from Shane, 1999








## Adult Support for Preschool Development of Number and Operations Concepts



### Materials, Environments, Experiences, and Language

Much of the development of number and operations skills can be attributed to the early experiences children have with numbers and counting. In addition to supporting children's emerging number and counting skills, adults must provide many opportunities for children to consider number operations (adding, taking away, etc.) and to see numbers represented in meaningful ways.

#### For example, adults can:

- ◆ Provide engaging materials for children to count and compare (e.g., blocks, rocks, animals)
  - ◆ Engage children in finger plays that involve counting, such as "Five Little Monkeys"
  - ◆ Model counting and take advantage of opportunities for children to count throughout the day (e.g., count the number of children present, spoons needed at each table during breakfast, or blocks in a block tower)
- 
- ◆ Use the question "how many" to encourage preschoolers to count, compare, and talk about quantity
  - ◆ Model and teach counting strategies such as touching objects, lining up objects, or pulling each object to the side after it is counted
  - ◆ Pose problems involving number, for example, "How many counting bears are in your little cup?" and "If you give me one, how many will you have?"
  - ◆ Provide materials and play games that represent number in different ways, such as playing cards, dominos, dice, and books
  - ◆ Encourage children to write numbers that are meaningful, such as their age, how many kinds of flowers they saw on a nature walk, or how many days until grandma comes to visit

## Adult Support for Preschool Development of Number and Operations Concepts



***Look for and listen to Number and Operations experiences and interactions in Head Start Programs***



Preschool Center-Based Classroom and Family Child Care Home	Home-Based Option Family Settings
During daily music time in the family child care home, Teacher and children sing, "Tameka, Tameka, what do you see? I see two fingers looking at me," as Tameka holds up two fingers.	Mr. and Mrs. Jones and son Terry have a deck of playing cards. They begin to match and organize them by their numbers and symbols. Then they play "Go Fish!"
When Teacher sees Tina and Bobby spontaneously placing Unifix cubes on their fingers, she remarks on the number of cubes on each hand. "How many do you have on one hand? On both hands together?"	As Mimi counts four spoons, the home visitor checks for her understanding of cardinality by asking, "So how many is that?" Mimi starts to count the spoons again instead of saying "four". The home visitor explains to Mimi's mother that this is not unusual for her age.
Three tricycles are parked in the corner of the outside play area. A picture sign of three children is posted beside the bikes so children can determine for themselves how many can ride at one time.	The home visitor shares the Head Start Family Cookbook during the visit. Anthony loves looking at the illustrated recipes. He and his mother decide to make fruit salad. The home visitor asks Anthony questions about how many and what kind of ingredients are needed.
Teacher and TJ use number and operations words such as "how many", "more than", and "one more" as they explore the book <i>The Very Hungry Caterpillar</i> .	Mario tells the home visitor he wants more crayons because he doesn't have enough. The home visitor asks him how many more he needs.
In the backyard of the family child care home, Tameka and Joy toss pinecones into hula hoops on the grass. Then they announce to everyone how many landed inside the hula hoops.	While playing a home-made game, the home visitor, Mario, Isabel, and their mother roll dice, then count the dots on the dice to see how far to move their markers. Their mother holds baby Gita as she tries to grab the dice.



## Language is Key—Birth to Five

Here are two Number and Operations scenarios featuring the *Follow the CAR* dialogic strategies. The strategies require adults to follow the child's lead and give the child time to talk. This encourages longer, richer conversations about children's interests and is a perfect opportunity to mathematize children's experiences.

### INFANT/TODDLER SCENARIO

Grandma Linda sits in a soft chair with infant Andrew on her lap. She gently bounces Andrew on her knee until he slightly stiffens his back and arms.

(FOLLOW) "Oh," Grandma says, "no more bouncing for you?" She stops bouncing and quietly supports his back and neck, smiling at him. He relaxes and smiles back. Grandma pulls a Pooh Bear puppet onto one hand. She places her gloved hand within Andrew's reach; he grasps one puppet hand.

(COMMENT) Grandma says, "You have one of Pooh's hands." She pauses and smiles at Andrew, slightly wiggling her finger. He grasps her finger a little harder and leans down to touch it with his mouth.

(ASK) Grandma says "Does Pooh's fur feel good on your mouth?" She pauses and waits again for him to orient himself.


(RESPOND) Andrew continues to hold the puppet's finger. As Grandma wiggles the puppet, his attention turns to the puppet's other hand. He slightly relaxes his grasp on the puppet's one hand and reaches for the other. Grandma moves the puppet close and says, "One hand, two hands."

(COMMENT) Andrew laughs and says, "Baa." Grandma leans her head close to him, saying, "What a clever little fellow you are noticing Pooh's two hands!"



### Follow the CAR

#### Follow the child's lead and then:

- ⇒ Comment and wait, or 
- ⇒ Ask question and wait, or
- ⇒ Respond and wait, or
- ⇒ Respond by adding a little more and wait, or
- ⇒ When speaking in the home language and a child says a word in English, repeat the word in the home language

## PRESCHOOL SCENARIO

Although Carlita speaks mostly Spanish at preschool, she sometimes uses English or switches between languages. Her teachers are bilingual, but primarily use Spanish. Teacher Jan sees Carlita playing in the housekeeping area and walks over to her. The following conversation takes place *in Spanish*.

(ASK) "Are you cooking?" says Teacher Jan. "No, I just went shopping," says Carlita.

(FOLLOW) "Would you like some help?" asks Jan. "OK. You count those," says Carlita (pointing to the pile of play food).

(COMMENT) Jan says, "You have a lot of food here." Jan pauses and waits until Carlita responds by saying, "Yep, but only one corn."

(ASK) When Carlita has finished organizing her purchases, Jan asks, "Are you going to share that one piece of corn?" She pauses and waits as Carlita thinks about this.

(REPETIR OTRA VEZ) "Yes," says Carlita, "I'm going to take out *all the little pieces*." Carlita code-switches, saying the phrase "all the little pieces" in English instead of Spanish. Jan repeats the phrase in Spanish.

(RESPOND and ASK) Jan pretends to divide the kernels of corn onto two plates. "How many kernels should go on each plate?" Jan pauses and waits for Carlita.

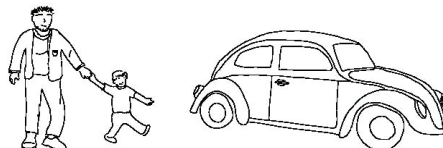
(REPETIR OTRA VEZ) "More for you because you're *bigger*," says Carlita, saying *bigger* in English. "Sí. Soy más grande," says Jan, repeating what Carlita says, in Spanish.



### Follow the CAR

#### Follow the child's lead and then:

- ⇒ Comment and wait, or
- ⇒ Ask question and wait, or
- ⇒ Respond by adding a little more and wait, or
- ⇒ When speaking in the home language and a child says a word in English, repeat the word in the home language



*Language Is the Key—Follow the CAR* is a multimedia resource distributed by the National Head Start Family Literacy Center. If your program does not have the book and DVD already, email [info@wlearning.com](mailto:info@wlearning.com).





## Ongoing Monitoring, Supervision, and Professional Development



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## Introduction

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This section is designed to help you ensure that Head Start and Early Head Start programs provide high quality experiences and individualized instruction related to Number and Operations. The first step in this process is to gather information through observation, self-assessment, ongoing monitoring, and child-outcomes data. Next, educational leaders need to analyze the information collected to come to conclusions about program-wide as well as individual teaching staffs' needs. Finally, decisions must be made about the training or supervisory approaches best suited to the needs, culture, strengths, and learning styles of your staff.

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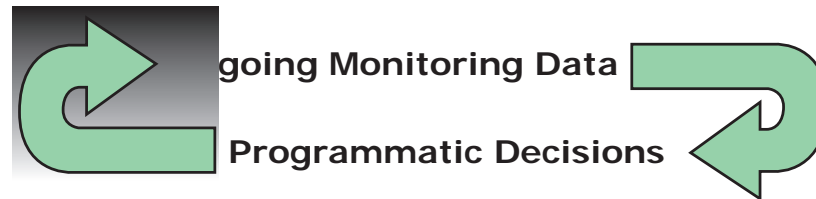
### The following pages contain resources about:

- ◆ Data collection through ongoing monitoring, classroom observation, and program self-assessment
- ◆ Mentoring and reflective supervision to support reflective practice and professional development
- ◆ Ongoing support of infant, toddler, and preschool children's development in the area of Number and Operations
- ◆ Professional development tools to support staff in center-based, family child care, and home-based program options



## Using Data from Ongoing Monitoring to Make Decisions

Head Start and Early Head Start programs are faced with the ongoing task of making decisions—both small and large—to ensure positive outcomes for children. Answers to challenges may surface quickly and be easily put into practice. Other times a more thorough approach is needed to define a problem, decide upon a solution, and plan for implementation.



The High Five Mathematize Guide is meant to help Head Start and Early Head Start leaders to 1) become more familiar with child development in the area of mathematics, 2) find out about the math strengths and needs of children and program staff, and 3) provide some professional development tools to meet staff needs and capitalize on existing strengths.

The following page provides four categories and questions to help organize an approach to decision-making about math teaching and learning. The categories are:

- ◆ Staff Behaviors and Teaching Practices
- ◆ Learning Environments and Materials
- ◆ Child Behaviors
- ◆ The School-Home Connection

In addition, there are dozens of Program Planning resources on the Early Childhood Learning and Knowledge Center (ECLKC) website at <http://eclkc.ohs.acf.hhs.gov>, as well as observation tools such as those listed to the right.

### Tools to Guide

#### Observation and Monitoring

1. SOLAR Infant/Toddler Classroom Staff Skill Profile (See Appendix)
2. OHS Math Environmental Scan (See Appendix)
3. OHS Math Number and Operations Webcast #2
4. OHS Monitoring Protocol: Education and Early Childhood Development

## Using Data from Ongoing Monitoring to Make Decisions

Ongoing monitoring, classroom and staff observations, and even informal classroom visits, provide opportunities to look for behaviors and environmental factors that support positive outcomes for children in Number and Operations.

### Staff Behaviors and Teaching Practices

- ♦ How do staff create learning experiences and environments to ensure children count, use numbers, and compare quantities throughout their day?
- ♦ How do planned and spontaneous conversations respond to children's questions and interest and foster vocabulary growth related to number and operations?
- ♦ How do staff use "math talk" or otherwise mathematize children's everyday moments to highlight a wide variety of numeracy concepts?
- ♦ How do staff involve families or guardians in number-related experiences?

### Learning Environments and Materials

- ♦ Do the learning environments (indoor and outdoor) have a range of materials available for learning about, exploring, and representing number and quantity?

### Child Behaviors

- ♦ Are children engaged in experiences and talking about: counting, numbers, adding and taking away, comparison of quantities, and solving number problems?

### The Home-School Connection

- ♦ Is information shared with families about how to support counting skills and number concepts at home?
- ♦ Is math a part of family-education, socializations, or parent meetings?
- ♦ Are families encouraged to think of themselves as mathematicians and empowered to help their children?



This teacher is modeling one-to-one correspondence as she points to and counts the snowballs with the preschoolers.



## Mentor Coaching and Reflective Supervision

Mentor-coaching and reflective supervision can help teaching and home visiting staff improve their professional practice. The mentor-coaching skills in the boxed-list are not specific to Number and Operations or any other child outcome. They are general skills for supervisors and mentors to consider and employ. Read the following examples to see how these skills can support staff and ultimately lead to positive Number and Operations outcomes for children.

*After noting that math outcomes in Operations are weak in some classrooms, the Education Manager establishes time each month for teachers to problem-solve how to “go beyond counting” in their math lesson plans.*

Staff ask to learn more “number and counting words” in children’s home languages. During the next in-service, teaching staff make counting books using multiple languages. Bilingual adults support this effort by sharing their linguistic knowledge.

*A third-year teacher feels discouraged after trying a new number game. Because of the teacher’s experience level, the supervisor asks for information instead of giving suggestions, to encourage the teacher to reflect. For example, “Describe the game.” and “What would you do differently next time?”*

The management team wants to use more classroom video-taping to improve individualization in the area of Number and Operations. Unit 4, Module 4 of the *Steps to Success Mentor-Coaching* box set focuses on “Using Video to Document Children’s Learning”.

### Mentor-Coaching Skills\*

- ◆ Professional Development Planning
- ◆ Setting Achievable Goals
- ◆ Problem Solving
  
- ◆ Relationship Building
- ◆ Sharing Values
- ◆ Culturally Sensitive Approaches
- ◆ Self-Reflection
- ◆ Communication, Listening, and Reflective Inquiry
  
- ◆ Observation and Use of Observation Tools
- ◆ Reflective Conferencing
- ◆ Journaling
- ◆ Providing and Receiving Feedback
  
- ◆ Child Assessment
- ◆ Individualizing Instruction

*\*See Appendix for additional resources about Mentor-Coaching.*

## Professional Development

### Ideas for Staff Working with Infants and Toddlers

**Mathematize** means to bring out, or highlight, math words or concepts during an interaction with a child or group of children. Adults mathematize in a variety of ways. The first step in mathematizing is to recognize math concepts embedded in what children are exploring or experiencing. Once adults “find the math” in a given moment, one way of mathematizing is to use math talk and simple math vocabulary with children.

To help staff think about the potential math talk in everyday situations and in children’s play, take pictures of staff in action! Then use those pictures to practice math talk or to brainstorm relevant vocabulary. You may focus the discussion on Number and Operations or another math area, depending on your staff’s strengths and needs.

The more teaching staff practice math talk, the more naturally they will use it in their conversations with children.

The pictures to the right are examples of caregivers with infants and toddlers. These pictures can prompt conversations about math talk related to number and counting concepts, vocabulary, and opportunities.

The caregiver, above right, uses sign language and verbal language to say, “You want more, more, more!” or “One more!” The Early Head Start teacher, right, talks with children about the numeral next to their name on the attendance sheet.



## Self-Assessment for Early Head Start Staff

		Number and Operations				
<p>This self-assessment* can be completed by Education Managers, supervisors, and/or teaching staff.</p> <p>The information can then be used, in a non-evaluative way, to make decisions about topics for program-wide training or used on an individual level with staff to provide tailored mentor-coaching or reflective supervision.</p> <p>Insight from the self-assessment may also help staff identify their own professional development goals.</p> <p>Page ahead to find additional self-assessments to use with Head Start staff and home-based staff.</p> <p><i>*See the end of the chapter for full-size versions of the Number and Operations Self-Assessments.</i></p>	Skills for Adults Working with Children Birth-3 Years of Age	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
	I know how our program's infant and toddler curriculum and assessment tools address number and operations.	1	2	3	4	5
	I understand what to expect infants and toddlers to know and be able to do related to understanding and using number and quantity words.	1	2	3	4	5
	I develop and write teaching plans that engage babies and toddlers in multi-sensory number experiences.	1	2	3	4	5
	I provide a variety of materials, manipulatives, objects, and toys that support exploring and learning about quantity.	1	2	3	4	5
	I have and use resources to support children's developing knowledge and skills related to number and operations.	1	2	3	4	5
	I use number words and describe quantity with infants and toddlers in daily routines and play (i.e., mathematize).	1	2	3	4	5
	I provide parents or guardians with information and ideas for number experiences to do at home.	1	2	3	4	5

## Professional Development

### Ideas for Staff Working with Infants and Toddlers

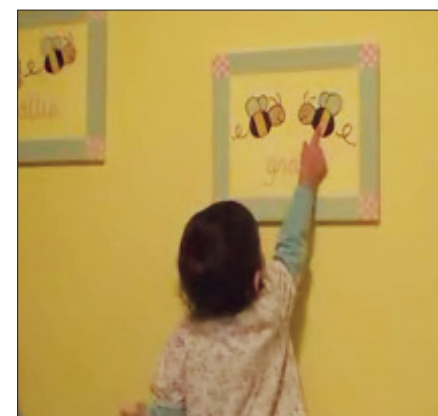
Another excellent training approach is to have staff analyze and discuss video clips of children in action. Two infant/toddler video clips are located on your High Five Mathematize DVD in the Number and Operations folder. The first video is called Cami Can Count! and the second video is called Kiss the Baby. The videos can be used for small or large group trainings, or with parents or family meetings.

#### "Cami Can Count!"

Before watching the clip of Cami, have the audience brainstorm and discuss the skills involved in counting (see page 29 for additional information). Then watch the clip for Cami's counting behaviors and skills, as well as the adult support given. You may want to watch the video more than once.

After watching the clip, use questions such as the following, to facilitate a discussion.

- ♦ What did you see?
- ♦ How would you describe Cami's counting abilities? What does she know? What is she still learning?
- ♦ What kind of additional support or scaffolding did the parent provide? What *more* could the adult have done to help Cami with her counting?



#### "Kiss the Baby"

Before watching the clip (from the *Steps to Success* DVD set), prepare the audience for what they will see. Baby Ashland and his caregiver are looking at a soft book with a reflective surface. The caregiver follows the baby's lead with comments, questions, and responses.

Use or modify the following questions to facilitate the discussion.

- ♦ What did you notice?
- ♦ What number-related concepts were embedded in baby Ashland's experience?
- ♦ How did the caregiver support the interaction?
- ♦ What *more* might she have done to mathematize the moment?



## Professional Development

### Ideas for Staff Who Work with Infants and Toddlers

Review the Early Head Start National Resource Center (EHSNRC) Tip Sheet No. 29 “Math and Science Development with Infants and Toddlers” plus Tip Sheet No. 29 Addendum. Both of these short documents contain information to help EHS staff gain insight and understanding about mathematics in the birth-to-three years.

Share the website or documents as a resource for staff to read on their own or use as a point of discussion during a staff meeting. The full documents may be accessed on the Early Childhood Learning and Knowledge Center (ECLKC) website at:

<http://eclkc.ohs.acf.hhs.gov/hslc/ecdh/eecd/Curriculum/Planning/DoesEarlyHeadS.htm>.

Below is an excerpt from Tip Sheet No. 29.

### Supporting Math and Science Discovery with Infants and Toddlers - EHSNRC Tip Sheet No. 29

#### Number and Quantity:

- ♦ Provide a variety of collections of objects for manipulating, organizing, comparing, and counting (plastic animals, cars, blocks, toy dishes, etc.)
- ♦ Identify small quantities of items (Child saying: “I got two!” “More juice.” Adult noting: “You found one of your shoes. Where’s the other one?” “We have two dolls—one for each of you.” “You have so many blocks!”)

#### One-to-One Correspondence (exploring how items go together in one-to-one-relationships):

- ♦ Provide an environment that contains a variety of objects that match up with one another (cars and garages, containers with lids, etc.)
- ♦ Point out one-to-one relationships during meaningful experiences (“There is one cup of juice for you, one cup for me, and one cup for Billy.”)



## Self-Assessment for Head Start Staff

		Number and Operations				
<p>This self-assessment* can be completed by Education Managers, supervisors, and/or teaching staff.</p> <p>This non-evaluative assessment information can assist in decision-making about professional development for all staff meetings, site-based trainings, or individual staff.</p> <p><i>*See the end of the chapter for full-size versions of the Number and Operations Self-Assessments.</i></p>	Skills for Adults Working with Children 3-5 years of age	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
	I know the specific indicators related to Number and Operations.	1	2	3	4	5
	I understand what to expect preschool children to know and be able to do related to counting, representing, and comparing quantities.	1	2	3	4	5
	I develop and write teaching plans to engage preschoolers in developmentally appropriate number and operation experiences.	1	2	3	4	5
	I watch for opportunities to pose number problems during children's daily routines and interactions (i.e. mathematize).	1	2	3	4	5
	I recognize and describe different strategies that children use to compare quantities.	1	2	3	4	5
	I understand the skills that underlie accurate counting (e.g., one-to-one correspondence, cardinality, etc.).	1	2	3	4	5
	I provide parents or guardians with information, activities, and counting-related experiences to do at home.	1	2	3	4	5
	I understand and have access to resources about children's developing knowledge and skills related to number.	1	2	3	4	5

## Professional Development

### Ideas for Staff Who Work with Infants and Toddlers

**Mathematize** means to bring out, or highlight, math concepts during an interaction with a child or group of children.

Using math talk is a critical way to highlight math concepts and vocabulary during interactions with children (Rudd, et al., 2008). Research shows using language related to counting, cardinality, and comparing, as well as posing number problems, is a powerful way to improve children's outcomes in the area of mathematics (Klibanoff, et al., 2006).

Findings included:

- ♦ The amount of math talk by teaching staff and day care providers ranged from 1 instance to 104 instances
- ♦ A "significant relation between the amount of math input in teacher speech and the growth of children's math skills over the year"
- ♦ Children from low, middle, and high socioeconomic groups all benefited and showed growth with increased math talk by teachers

Such findings suggest a number of practical implications. First, supervisors and education managers need to observe teachers, day care providers, and other adults working with children to identify the amount and type of math talk they use with children. Second, teachers need to be aware of the strong, positive impact their use of math talk has on children. Finally, it is important for teachers to participate in trainings, and to have other opportunities to practice and learn more about how to incorporate math talk into their interactions with children.



Share the importance of math talk with staff and set-aside time for them to practice. One way to practice is to take photographs of your teaching staff. Then use those photographs to brainstorm relevant math vocabulary and concepts.

### Ideas for Staff Working with Preschoolers

Number and Operations is one of the most important areas of math during early childhood development. Staff need a deep and thorough knowledge of key indicators.

A useful approach to gain deeper understanding of key number and operations indicators is to have staff compare content of these indicators with their program’s local curriculum, assessment tools, and practices.

Help staff consider and discuss the language of the indicators as well as their own planning and ongoing assessment of children. Use the following worksheet to do so.

Number and Operations Indicator	How do our preschool curriculum materials and resources address or support this Indicator?	How do our preschool <i>ongoing assessment</i> practices address this indicator?
Demonstrates increasing interest and awareness of numbers and counting as a means for solving problems and determining quantity.		
Begins to associate number concepts, vocabulary quantities and writing numerals in meaningful ways.		
Develop increasing ability to count in sequence to 10 and beyond.		
Begins to make use of one-to-one correspondence in counting objects and matching groups of objects.		
Begins to use language to compare numbers of objects with terms such as more, less, greater than, fewer, equal to.		
Develop increased abilities to combine, separate and name “how many” concrete objects.		

The above worksheet\* was developed to help staff better understand Number and Operations Indicators. This training approach and worksheet can be used as a way for leaders to gain insight into their staff’s understanding OR as a culminating activity at the end of a math training to see how well staff have understood the content.

Management or leadership teams may also use this worksheet, or a modified version, to review if and how Number and Operations outcomes data is collected, tracked, analyzed, and used.

\*Worksheet can be found at the end of this chapter.



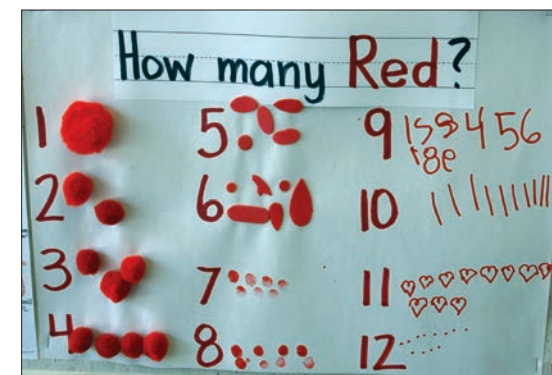
## Professional Development

### Ideas for Staff Working with Preschoolers

“How many?” is a key question for children who are learning about counting, numerals, comparing quantities, and numerical problem solving. “How many” questions can be asked in informal settings or be more formalized, for example, by being organized into a graph.

Education managers or site supervisors can share the document *Using Graphs and Charts to Help Children Represent “How Many”*\* with teachers and child care providers. The list of questions below can be used to prompt discussion about math concepts and skills involved in creating and understanding number-based graphs and charts, child development in the area of representing number (from concrete to abstract), or integrating math throughout the curriculum. The following questions were asked (and graphically represented) in a Head Start program over many months.

- ♦ How many letters are in your name?
- ♦ How many children’s names start with the letter A? B? C?
- ♦ What do you like to drink during snack time? Milk? Grape juice? Water?
- ♦ What is your favorite weather? Sunny? Rainy? Cold?
- ♦ How many children liked Granny Smith apples best?
- ♦ What color did you wear today? Red? White? Pink?
- ♦ Did you like the Russian Pilmany [bread]? Yes? No?
- ♦ How many children rode a bike with training wheels? A tricycle? A scooter?
- ♦ How many squeezes of a wet sponge will fill our container to the top?



Graphic organizers, such as tables and charts (like those pictured right\*) can be used to address the following Number and Operations Indicators:

- ♦ Develops increased abilities to combine, separate, and name “how many” concrete objects
- ♦ Begins to associate number concepts, vocabulary, quantities, and written numerals in meaningful ways

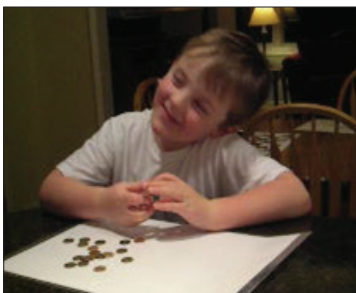
\*Go to the end of this chapter for the full photo-document.

## Professional Development

### Ideas for Staff working with Preschoolers

Use video footage, like the example of Jonathan playing “The Penny Game”, with staff during in-service or training days. The two video clips of 4-year-old, Carter, and his 5½-year-old brother, Leo, help to demonstrate the development of number conservation. Conservation means knowing that a quantity can only be changed by adding or removing objects from the group. Simply moving objects around so they look different does not change the quantity. The three videos can be found on the High Five Mathematize DVD.

#### "Conservation Task with Carter and Leo"



Leo (pictured left) and his brother Carter are asked to count and compare two rows of pennies. The adult in the video changes the way one of the rows appears (without adding or removing any pennies) and then asks a series of comparing questions. “Does my row have more, does your row have more, or do we both have the same?” Use the children’s responses to discuss this important developmental milestone with staff.

Use or modify the following questions to prompt discussion about the videos.

- ♦ What did you notice?
- ♦ What do Carter and Leo’s responses tell us about their developmental levels?
- ♦ What type of comparison strategies do the two boys use?

#### "The Penny Game"



“The Penny Game” is a hidden object game that requires counting, combining (addition), and separating (subtraction) of quantity. The video can be used in its entirety or broken down into short clips for staff to watch, re-watch, and discuss.

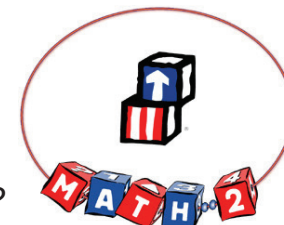
Use or modify the following questions to prompt discussion about the video.

- ♦ What did you notice?
- ♦ What did Jonathan do successfully? What was challenging for him?
- ♦ How would you individualize to meet Jonathan’s strengths and needs?



Along with the full-length **Number and Operations Webcast #2**, the following video lessons are available on the **ECLKC Website**:

- ♦ Hoola Hoop Game Lesson
- ♦ Number Assessment Lesson
- ♦ How Many Are Hiding? Lesson
- ♦ Five Creatures Lesson
- ♦ Number Stations Lesson
- ♦ Penny Activity Lesson



## Professional Development

### Ideas for Staff working with Preschoolers

Learning songs, poems, and finger plays should be a regular part of a preschool experience. Site supervisors, training coordinators, or education managers can create a collection of songs or finger plays for staff to analyze, using a Number and Operations lens. That means asking staff to consider a song like “Five Little Monkeys Swinging in the Tree”\*, and looking for counting, addition or subtraction, cardinality, one-to-one correspondence, and number representation embedded in the lyrics and the accompanying hand-motions.

#### Five Little Monkeys Swinging in the Tree\*

Five little monkeys swinging in the tree,  
Teasing Mr. Alligator, “Can’t catch me! Can’t catch me!”  
Along came Mr. Alligator, quiet as can be  
And he SNAPPED one monkey right out of that tree!  
(Repeat lyrics counting down from five to “no more” monkeys swinging in the tree.)

#### Other children’s songs, poems, and finger plays featuring number and operations

- ♦ 5 Little Ducks
- ♦ Roll Over (10 in the Bed)
- ♦ 5 Little Monkeys Jumping on the Bed
- ♦ The Ants Go Marching (One-by-One)
- ♦ 5 Little Speckled Frogs
- ♦ 5 Little Pumpkins Sitting on a Fence
- ♦ Over in the Meadow
- ♦ Un Elefante Se Balanceaba (o Se Columpeaba)

Help staff recognize and describe the math language and concepts embedded in their favorite children’s songs, poems, chants, and finger plays, like “Five Little Monkeys” or those listed below left.

#### Ask staff to look at the song and find:

- ♦ Words related to number or quantity
- ♦ Counting sequence
- ♦ Addition or subtraction of objects
- ♦ One-to-one correspondence

#### Ask staff how they might extend this song:

- ♦ What questions could you ask children about this song that highlight number or operations?
- ♦ What extension activities would emphasize the number concepts in this song/poem/chant?
- ♦ How could you make the number and operations in this song more concrete (hands-on) for children?
- ♦ How could you make the song simpler? More complex?

\*Go to the end of this chapter for the complete song lyrics.

## Self-Assessment for Home-Based Staff

This self-assessment\* can be completed by Education Managers, supervisors, and/or teaching staff.

This non-evaluative assessment information can assist in decision-making about professional development for all staff meetings, site-based trainings, or individual staff.

*\*See the end of the chapter for full-size versions of the Number and Operations Self-Assessments.*

Skills for Adults Working with Parents and Children in the Home-Based Program Option	Number and Operations				
	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
I know my program's Number and Operations Indicators.	1	2	3	4	5
I understand what young children should know and be able to do related to counting and comparing quantities.	1	2	3	4	5
I help families and caregivers feel comfortable and confident in their ability to mathematize or talk about numbers, counting, and simple operations.	1	2	3	4	5
I show families how to pose number problems during children's daily routines and interactions.	1	2	3	4	5
I develop and write teaching plans to engage children and families in multi-sensory, numeracy experiences.	1	2	3	4	5
I provide parents or guardians with information, activities, and number-related experiences to do with their children.	1	2	3	4	5
I point-out and discuss materials that relate to numbers that families already have in their homes (e.g., playing cards and calendars).	1	2	3	4	5



## Professional Development

### Ideas for Staff Working in Home-Based Program Option

Head Start and Early Head Start staff who conduct home-visits are in an unique position to support both children and their families simultaneously. Have home visiting staff analyze and discuss if and how they might use the following resource, *A Family Note on Finding the Math\**, during a home visit or group socialization to encourage positive child outcomes in Number and Operations.

The National Head Start Family Literacy Center created a resource for families called *A Family Note on Finding the Math*.\*

The note begins with an introductory letter to parents, then shows examples of language and interactions related to:

- ♦ Math during everyday home routines (see excerpt, left)
- ♦ Math when at the grocery store
- ♦ Math when at the park

The note ends with seven key points about how families can support their children's math learning in fun, appropriate, *critical* ways.



Here are some ideas to help children learn math during everyday home routines.

#### Getting dressed



"How many buttons do you have on your shirt? Let's count them as I button you up."

*Number—counting*

"Here's a sock for this foot. That's **one** foot. Here's a sock for the other foot. That's **two** feet!"

*Number—counting, using one-to-one correspondence*

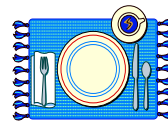
"Look, the stripes on your socks make a **pattern** – blue, white, green, blue, white, green!"

*Repeating patterns*

"Do you want to wear your **short** pants or your **long** pants?"

*Measurement—comparing sizes*

#### Setting the table



"Will you help me? **Each person** gets **one** fork, **one** spoon, and **one** napkin."

*Number—using one-to-one correspondence*

Point out the **repeating pattern** in the way your family sets the table. For example, "The fork goes on this side, then the plate, and then the spoon. We do it **the same way every time!**"

*Repeating patterns*

"How many spoons do we need? Let's **count**."

*Number—counting, solving problems*

\*See the end of this chapter for the complete document.

## Professional Development

### Ideas for Staff Working in Home-Based Program Option

Head Start and Early Head Start staff who conduct home-visits are in the unique position to support both children and their families simultaneously. Head Start programs need to support positive child outcomes in Number and Operations. Create time for home visiting staff (in small groups) to read and answer the three questions below about the examples in the “What to Look For and Listen To” list below.

#### WHAT TO LOOK FOR AND LISTEN TO

##### In Home-Based Option Family Settings

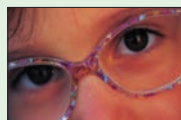
When the home visitor arrives, she asks, “Did you play the hula hoop game that we played last week?”

Mario tells the home visitor he wants more crayons because he doesn’t have enough. The home visitor asks him how many more he needs.

The home visitor and parent teach Terry to represent numbers in more than one way. He draws a picture of three fish; then his parent writes the numeral 3 and suggests Terry copy it onto the picture.

While playing a home-made game, the home visitor, Mario, Isabel, and their mother roll dice, then count the dots on the dice to see how far to move their markers.

After Mimi brushes her teeth, the “Getting into Bed” game begins. Her mother slowly counts. Mimi tries to get under the covers before her mother counts very high.



**Answer the following questions about the examples in the “What to Look For and Listen To” table.**

- ♦ What number and operations concepts are embedded in this moment?
- ♦ Have I seen or heard this during a home visit?
- ♦ What would I do to extend or mathematize this moment while still following the child or family’s interest?



## Notes





## Self-Assessment for Early Head Start Staff Number and Operations

<b>Skills for Adults Working with Children Birth-3 Years of Age</b>	<b>I am not skilled in this area</b>	<b>I am somewhat skilled in this area</b>	<b>I am highly skilled in this area</b>
I know how our program's infant and toddler curriculum and assessment tools address number and operations.	1	2	3
I understand what to expect infants and toddlers to know and be able to do related to understanding and using number and quantity words.	1	2	3
I develop and write teaching plans that engage babies and toddlers in multi-sensory number experiences.	1	2	3
I provide a variety of materials, manipulatives, objects, and toys that support exploring and learning about quantity.	1	2	3
I have and use resources to support children's developing knowledge and skills related to number and operations.	1	2	3
I use number words and describe quantity with infants and toddlers in daily routines and play (i.e., mathematize)	1	2	3
I provide parents or guardians with information and ideas for number experiences to do at home.	1	2	3





## Self-Assessment for Head Start Staff Number and Operations

<b>Skills for Adults Working with Children 3-5 years of age</b>	<b>I am not skilled in this area</b>	<b>2</b>	<b>I am somewhat skilled in this area</b>	<b>4</b>	<b>I am highly skilled in this area</b>
I know the specific indicators related to Number and Operations.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I understand what to expect preschool children to know and be able to do related to counting, representing, and comparing quantities.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I develop and write teaching plans to engage preschoolers in developmentally appropriate number and operations experiences.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I watch for opportunities to pose number problems during children's daily routines and interactions (i.e. mathematize).	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I recognize and describe different strategies that children use to compare quantities.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I understand the skills that underlie accurate counting (e.g., one-to-one correspondence, cardinality, etc.).	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I provide parents or guardians with information, activities, and counting-related experiences to do at home.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I understand and have access to resources about children's developing knowledge and skills related to number.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

## How Do Our Preschool Curriculum and Assessment Practices Address Number and Operations Indicators?

Number and Operations Indicators	How do our preschool curriculum materials and resources address or support this Indicator?	How do our preschool <i>ongoing assessment</i> practices address this Indicator?
Demonstrates increasing interest and awareness of numbers and counting as a means for solving problems and determining quantity.		
Begins to associate number concepts, vocabulary, quantities and written numerals in meaningful ways.		
Develops increasing ability to count in sequence to 10 and beyond.		
Begins to make use of one-to-one correspondence in counting objects and matching groups of objects.		
Begins to use language to compare numbers of objects with terms such as more, less, greater than, fewer, equal to.		
Develops increased abilities to combine, separate and name "how many" concrete objects.		

## Using Graphs and Charts to Help Children Represent "How Many"

Graphs and charts show numbers and quantities represented in a variety of ways. The following photographs provide teachers with examples of how to use graphic representations to include math across the curriculum. Doing so can help address key Number and Operations Indicators:

- ◆ Develops increased abilities to combine, separate, and name "how many" concrete objects
- ◆ Begins to associate number concepts, vocabulary, quantities, and written numerals in meaningful ways



How did you share your cookies?

What letter starts your first name!

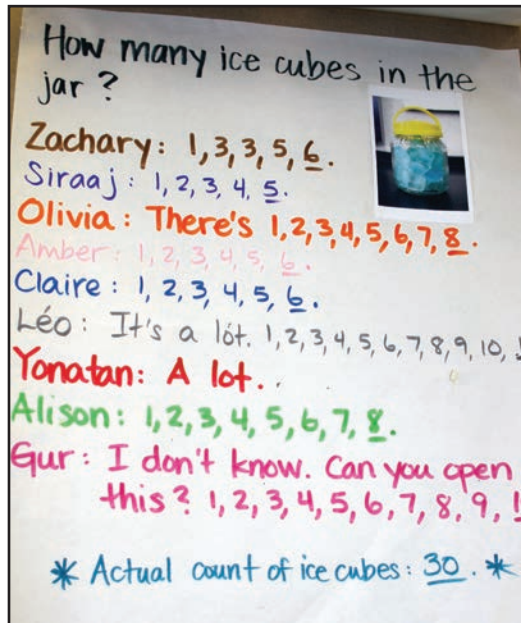
A	B	H	J	K	L	M	R	T	S
Aleksan Andreana Andreanik America Arvin T. Arminch	T. Bertha	Hamlet T. Henryka	Jade Jeremiah Joseph	Kevin	Levon Lili	Maria Mark Madelyn Matthew Melanie Michael	Reneh Rya	T. Tina	T. Siranoosh
6	1	2	3	1	2	6	2	1	1

How many names start with the letter 'A'?

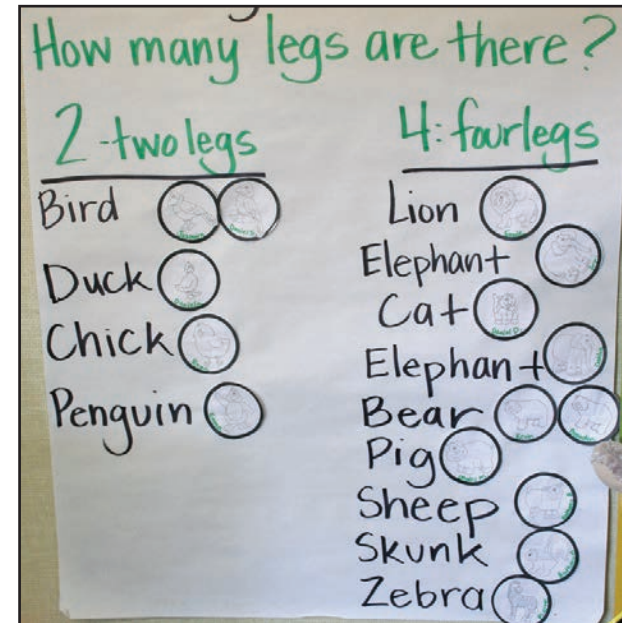


Which kind of shells do we have the most of?

# Using Graphs and Charts to Help Children Represent "How Many"



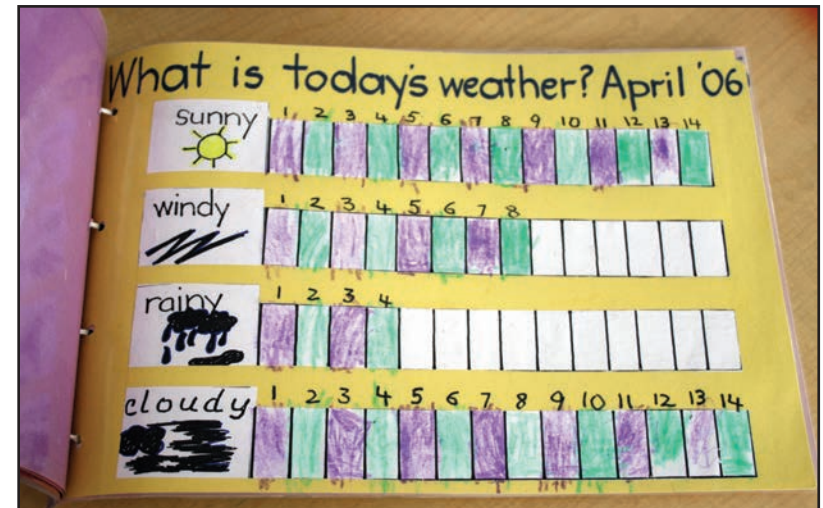
Amber and Claire guessed the same number of ice cubes - six.



Let's count how many legs two bears have all together.



Can you find four orange plastic children?



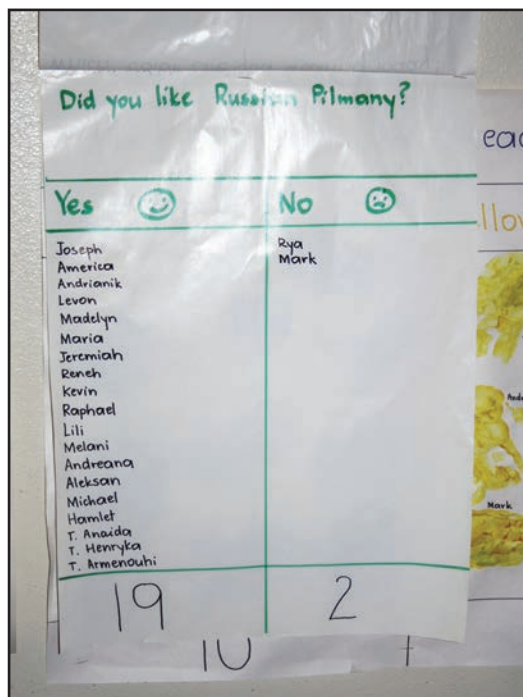
Did we have more sunny days or more rainy days in April?



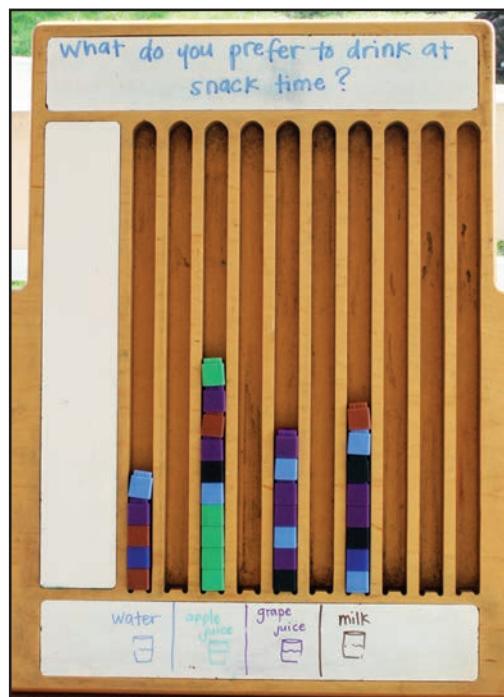
# Using Graphs and Charts to Help Children Represent "How Many"



Let's count and see if there are 11 red hearts on our chart.



How many children did not like the Russian Pilymany bread?

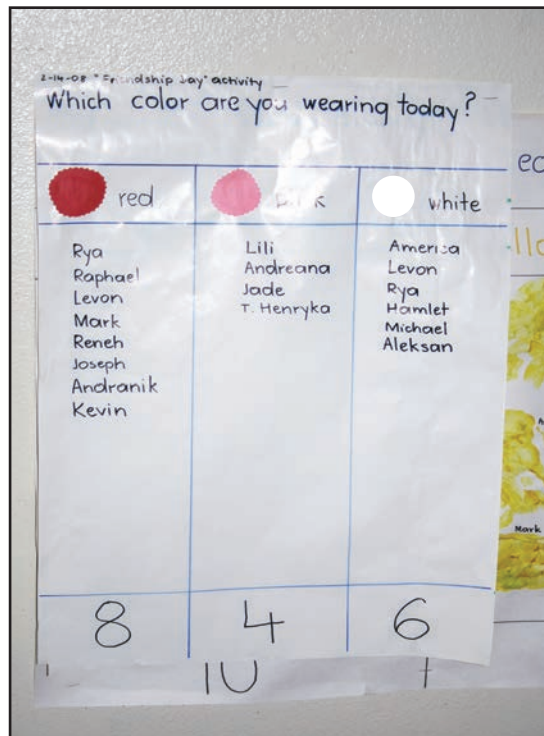


What drink do children like most at snack?

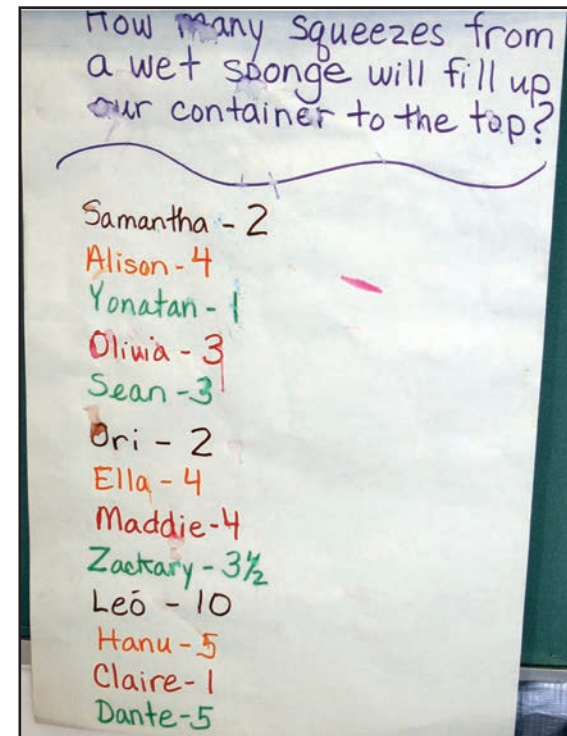


How many children rode bicycles and tricycles on bike day?

## Using Graphs and Charts to Help Children Represent "How Many"



Which color did children wear more, pink or white?



Leo guessed ten squeezes and Claire only guessed one.



How many children have a birthday in the same month as you?

## **Five Little Monkeys Swinging in the Tree**

Author: Unknown

Five little monkeys swinging in the tree  
teasing Mr. Alligator can't catch me....can't catch me  
along came Mr. Alligator quiet as can be  
and snapped one monkey out that tree

Four little monkeys swinging in the tree  
teasing Mr. Alligator can't catch me....can't catch me  
along came Mr. Alligator quiet as can be  
and snapped one monkey out that tree

Three little monkeys swinging in the tree  
teasing Mr. Alligator can't catch me....can't catch me  
along came Mr. Alligator quiet as can be  
and snapped one monkey out that tree

Two little monkeys swinging in the tree  
teasing Mr. Alligator can't catch me....can't catch me  
along came Mr. Alligator quiet as can be  
and snapped one monkey out that tree

One little monkeys swinging in the tree  
teasing Mr. Alligator can't catch me....can't catch me  
along came Mr. Alligator quiet as can be  
and snapped one monkey out that tree

No more monkeys swinging in the tree!





## Self-Assessment for Home-Based Staff Number and Operations

	I am not skilled in this area	2	I am somewhat skilled in this area	3	4	I am highly skilled in this area	5
<b>Skills for Adults Working with Parents and Children in the Home-Based Program Option</b>							
I know my program's Number and Operations Indicators.	1	2	3	4	5		
I understand what young children should know and be able to do related to counting and comparing quantities.	1	2	3	4	5		
I help families and caregivers feel comfortable and confident in their ability to mathematize or talk about numbers, counting, and simple operations.	1	2	3	4	5		
I show families how to pose number problems during children's daily routines and interactions.	1	2	3	4	5		
I develop and write teaching plans to engage children and families in multi-sensory, numeracy experiences.	1	2	3	4	5		
I provide parents or guardians with information, activities, and number-related experiences to do with their children.	1	2	3	4	5		
I point-out and discuss materials that relate to numbers that families already have in their homes (e.g., playing cards and calendars).	1	2	3	4	5		





## A Family Note on Finding the Math

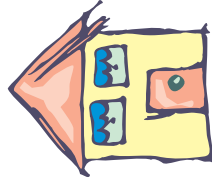
Young children begin to develop math concepts and skills very early in the first year of life. Family members play a special role in helping children learn about math. Throughout the day, as families talk, play, or carry out routines, children are learning. Family Notes show ways that families can use everyday experiences to help their young children learn math.

Families can use the ideas presented here to identify math learning opportunities in their own daily interactions with their children. Home visitors and family service staff can share this information with families to help them support children's math learning.

Some important things to consider:

- Math experiences should provide for fun, shared times between families and their children. Children will build a positive attitude toward math learning and toward learning in general.
- Children need experiences handling and working with things. They need to look at, hold, count, stack, and explore the characteristics of things. While children are actively exploring, adults can “mathematize” children’s play. By introducing mathematical words and talking about the experience, family members help children understand the meaning of numbers, shapes, and other math concepts. For example, while children are playing with blocks, adults can describe blocks by using words such as **curved**, **straight**, **longer**, and **shorter**. Children hear new math vocabulary and deepen their understanding about characteristics of blocks at the same time.
- Children need repeated experiences. Just as children enjoy hearing the same books over and over, they need to handle materials and do things again and again. Over time, children need to practice these experiences again, so they recall what they have learned. In this way, they deepen their understanding and develop new concepts.
- Family involvement in children’s learning is extremely important. It especially helps children’s learning when adult family members use the language they speak best. When adults speak in their home language, they are more likely to have deep, meaningful conversations and use rich, descriptive words. This type of language helps children to deepen their understanding of ideas and concepts.

- Families can observe their children’s interests and use those interests to build an understanding of math. For example, if a child goes to a slide in a park, adults can talk about position words like **behind** and **on top** of the slide. Children’s interest in the outdoors helps them learn about math! Children learn best when they are engaged in activities that interest them. Adults can support math learning by encouraging children to notice mathematical relationships, use math language, and practice math skills as they play.
- It is important that adults talk with children about what they are seeing, hearing, and doing. Families can support math learning by commenting on or asking children questions about math experiences. Give children time to respond. Wait at least five seconds before expecting young children to practice math and vocabulary when they talk with adults or other children about their math experiences.



Here are some ideas to help children learn math during everyday home routines.

### Getting dressed



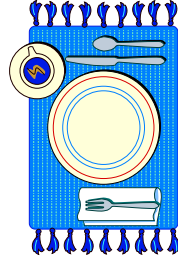
“**How many** buttons do you have on your shirt? Let’s count them as I button you up.”  
[Number—counting](#)

“Here’s a sock for this foot. That’s **one** foot. Here’s a sock for the other foot. That’s **two** feet!”  
[Number—counting, using one-to-one correspondence](#)

“Look, the stripes on your socks make a **pattern** – blue, white, green, blue, white, green!”  
[Repeating patterns](#)

“Do you want to wear your **short** pants or your **long** pants?”  
[Measurement—comparing sizes](#)

### Setting the table



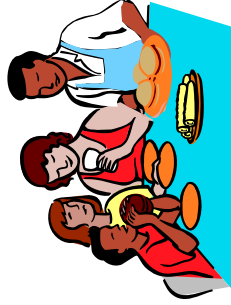
“Will you help me? **Each person** gets **one** fork, **one** spoon, and **one** napkin.”  
[Number—using one-to-one correspondence](#)

Point out the **repeating pattern** in the way your family sets the table. For example, “The fork goes on this side, then the plate, and then the spoon. We do it **the same way every time!**”  
[Repeating patterns](#)

“**How many** spoons do we need? Let’s count.”  
[Number—counting, solving problems](#)

“Give the **big** cup to daddy. I would like to have a **little** cup.”  
[Measurement—comparing sizes](#)

## Eating a meal



"Your sandwich looks like a **square**. If I cut it this way (corner to corner), what shapes will it make?"

Geometry—recognizing shapes

"**How many** pieces of cheese do you want?" "Do you want **one** or **two**?" "Let's count **how many** raisins you have."

Number—counting

"You have **more** pieces of apple than I do."

Number—comparing number of objects

## Picking up toys



"Let's put your cars **on** the shelf and the balls **in** the box."

Spatial Sense—recognizing positions of objects

"Can you put your **three** trucks here?" "There should be **six** dinosaurs. Will you **count** them and make sure they are all there?"

Number—counting

"You can put away the **square** pieces. Your brother will put away the **round** ones."

Geometry—recognizing shapes





Here are some ideas to help children learn math when at the grocery store.

### Making the shopping list

“How many apples do we need so each person in the family gets **one**?” Encourage your child to use fingers to show **how many** people in the family (and **how many** apples to buy).  
[Number—counting, solving problems](#)



Involve your child in making **tally marks** or writing **numerals** (written numbers) next to items on the list to indicate “**how many**.” Encourage your child to make his own grocery list too.  
[Number—recording “how many”](#)

### Shopping at the store



Point out the **numerals** that you see at the store, for example, “**2** for \$**1**” or aisle numbers. Encourage your children to find more **numerals** as you shop.  
[Number—recognizing numerals](#)

**Count** apples, oranges, carrots, peppers, and other items with your child as you put them into bags or the shopping cart.  
[Number—counting](#)

Talk with your child about **sizes** of items, such as cereal boxes or cartons of milk.

[Measurement—comparing sizes](#)

Look for **shapes** (e.g., circles, rectangles, or triangles) as you go through the store. Play a game with your child. Find a **shape**, such as the **rectangle** on the front of a cereal box, and then look for other items with the same **shape**.  
[Geometry—recognizing shapes](#)

At the checkout counter

“We should have **five** cans of soup. Let’s **count** and make sure.”  
[Number—counting, solving problems](#)



Point out the **numerals** on the cash register display and talk about what they mean (shows how much each thing costs).  
[Number—recognizing numerals](#)

Explain that the routine of going to the grocery store is a **repeating pattern**. “We go to the store, we pick out the food, we pay at the counter, and we go home and eat the food. Next week we will do the same thing.”  
[Patterns—recognizing repeating patterns](#)



Here are some ideas to help children learn math when at the park.

### Going to the park

“There’s a squirrel **on** the branch of the tree.”

**Spatial Sense**—recognizing positions of objects



“Let’s look for written **numbers** as we go to the park. What **numbers** do you see?”

**Number**—recognizing numerals

Encourage children to notice patterns in nature – for example, the **symmetrical patterns** in leaves or the petals on a flower.

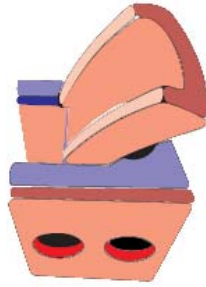
Look for **repeating patterns** – for example, the ridges and grooves of the bark on some trees. At the park, or coming or going, help children collect natural materials such as leaves, small sticks, or pebbles to use in making their own **repeating or symmetrical** patterns.

**Patterns**—recognizing and creating patterns

“First we go past Tina’s house. Next, we turn right at the corner by the library. The park is **close** to the library.”

**Spatial Sense**—learning about direction and location

### On the play structure



Encourage your child to climb **on** play equipment, jump **off** a small step, walk **backwards**, or crawl **through** a tunnel.

**Spatial Sense**—recognizing position and direction

“Let’s **count** the children on the swings. **One, two, three, four!**”

**Number**—counting

“The play structure has a **round** window. It looks like a **circle**.”

Do you see any other **circles**? Let’s look around.” “Let’s make the same **shape** in the sand.”

**Geometry**—recognizing shapes

## Having a snack



Ask your child to pass out the snack. “Will you pass out the snack? **Each person** gets **a box** of raisins.”

**Number**—using *one-to-one correspondence*

**Count** the food items as they eat them. “I have **four** carrots. **How many** do you have? Do you have **more** than four carrots or **fewer** than four carrots?”

**Number**—*counting and comparison*

“What **shape** do you think the cracker is? It has four **straight sides**.”

**Geometry**—*identifying shapes*





A Family Note on  
**Finding the Math**

Things to remember:

- Family members play a special role in helping children learn about math. Children learn when adults support their talk, play, and routines.
- Math experiences should be fun, shared times between adults and children. These build children's positive attitude toward math and learning.
- Children need experiences handling and using toys and other objects and exploring their characteristics. Adults "mathematize" children's play by introducing mathematical words about what they are doing. This helps children learn new math vocabulary and deepen their math concepts.
- Children need repeated experiences. Handling materials and doing things again and again helps children develop new concepts and deepen understanding.
- It especially helps children's learning when adult family members speak to young children using the language they are most comfortable with and when they use rich, descriptive words.
- Children learn best when they are engaged in activities that interest them. Families support learning when they observe children's interests and use them to help children build their math concepts and skills.
- It is important that adults engage children in conversations about what they see, hear, and do by commenting on or asking children questions about math experiences. Don't forget to wait at least 5 seconds before expecting children to answer!





# Geometry and Spatial Sense

*You say ball and I say sphere.  
Learning geometry makes it clear.  
In, out, under, beside, around.  
Spatial sense won't let us down.*





# Geometry & Spatial Sense

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## Introduction

This chapter discusses the ways infants, toddlers, and preschoolers develop geometry knowledge and spatial sense, and how families, Head Start staff, and Early Head Start staff support that development. Geometry is the area of mathematics that concerns shape and space. In the early years geometry primarily involves learning about shapes: what they look like, what they can do, and what they're called. Spatial sense refers to reasoning about how one's body moves in relation to objects in the environment and how objects fit together and can be moved in space. Spatial concepts include position/location, order, and directionality.

During the infant and toddler years, children explore shapes through hands-on experiences with different objects. They develop spatial sense through movement experiences such as being picked up, crawling, and walking. They also learn spatial concepts by manipulating materials such as nesting cups and shape sorters.

During the preschool years, children learn to name common two and three dimensional shapes (2-D, 3-D), and begin to learn to identify shapes by their attributes (such as the number of sides or angles). Spatial sense continues to develop as preschoolers engage in activities that require them to think about spatial relations, such as building with blocks, working puzzles, climbing, or playing ball with a friend.



### Geometry and Spatial Sense Terms

- ◆ Geometry
- ◆ Spatial sense
- ◆ Attribute
- ◆ Two-dimensional shapes
- ◆ Three-dimensional shapes
- ◆ Composing and Decomposing shapes
- ◆ Transformation

*See Appendix for Glossary.*

### Geometry and Spatial Sense Indicators

- ◆ Begins to recognize, describe, compare and name common shapes, their parts and attributes
- ◆ Progresses in ability to put together and take apart shapes
- ◆ Begins to be able to determine whether or not two shapes are the same size and shape
- ◆ Shows growth in matching, sorting, putting in a series, and regrouping objects according to one or two attributes such as color, shape or size
- ◆ Builds an increasing understanding of directionality, order and positions of objects, and words such as up, down, over, under, top, bottom, inside, outside, in front, and behind



## Infant and Toddler Development

This section focuses on infants' and toddlers' development of geometry and spatial sense. First, read about the developmental highlights for infants and toddlers. Then, consider the ways in which classroom teaching staff, child care teaching staff, and families can support learning in this area.



*"Geometry is the domain that connects mathematics with the real, physical world."*

- Sarama & Clements 2009,  
p201

Infants and toddlers explore shapes and spatial relations as they play with objects and with people. They use their whole bodies to explore and learn.

They manipulate objects to find out about their properties or attributes: *How does it feel? What can it do? and What can I do with it?* They relate objects in play; for example, when they put their hands together or in their mouth, and they put toys or other objects *on, in, or next to* other objects.

They develop their spatial sense as they learn to move through their environments by being held, crawling, walking, dancing, and running.

Adults support infants' and toddlers' learning about shapes and spatial sense by setting up the environment with opportunities to explore and learn, and through their interactions.

## Learning About Shapes

Infants begin to learn about shapes in their first year of life as they manipulate and explore objects. For example, a teething ring is round and smooth with no sharp edges or points, and one block can stack on top of another. After hearing adults label and talk about shapes, toddlers can begin to learn the names of shapes and then begin to use shape vocabulary such as circle and square.

### Infants and Toddlers:

- ♦ Grasp objects and explore them with their hands and mouth (Belsky & Most, 1981)
- ♦ Explore the properties of objects, such as size and shape or straight versus curved surfaces, by fingering, banging, throwing, and rolling (Palmer, 1989)
- ♦ Put objects together in ways that are consistent with their overall properties; for example, putting smaller objects inside larger objects or stacking two blocks that are the same size (Forman, 1982; Sinclair, et al., 1989)
- ♦ Begin to put shapes together; for example, putting shapes in a shape sorter using trial and error (Parks, 2004)
- ♦ Begin to identify basic shapes by their names such as circle, square, and triangle (Fuson & Murray, 1978; Clements & Sarama, 2009)

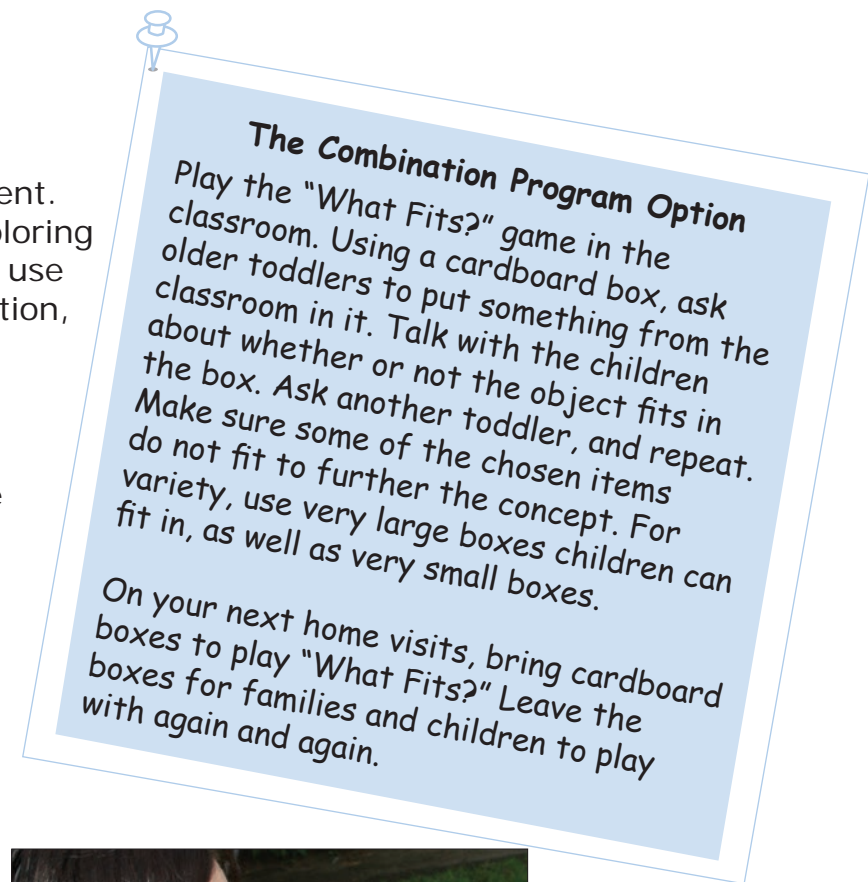


## Developing Spatial Sense

Infants' spatial sense begins to develop in their earliest interaction with the people and objects in their environment. As they explore and learn about shape, they are also exploring and learning about spatial relations. Infants and toddlers use their whole bodies to learn about spatial concepts of position, location, and directionality.

### Infants and Toddlers:

- ♦ Observe people and objects as they move through the environment
- ♦ Roll over, sit up, grasp objects, and pull things toward themselves
- ♦ Experiment with what they can do with objects; for example, drop a spoon and watch it fall or see where it landed
- ♦ Crawl and walk around their environment and hold and carry toys and other objects
- ♦ Actively explore how objects, especially their own bodies, fit and move in space (e.g., fill containers and dump out the contents again and again, or try to fit into spaces that are smaller or bigger than they are, like a box or baby doll crib)
- ♦ Hear and begin to use spatial language like "up" and "down", "in" and "out" (Hart & Risley, 1999; Internicola & Weist, 2003)



### **The Combination Program Option**

Play the "What Fits?" game in the classroom. Using a cardboard box, ask older toddlers to put something from the classroom in it. Talk with the children about whether or not the object fits in the box. Ask another toddler, and repeat. Make sure some of the chosen items do not fit to further the concept. For variety, use very large boxes children can fit in, as well as very small boxes.

On your next home visits, bring cardboard boxes to play "What Fits?" Leave the boxes for families and children to play with again and again.





## Adult Support for Infant and Toddler Development of Geometry and Spatial Sense Concepts



### Materials, Environments, and Experiences

For infants and toddlers, significant learning occurs in the course of their play, daily routines, and interactions with the adults in their daily lives. Adults should provide safe experiences that encourage their developing understanding of geometry and spatial sense.

#### For example, adults can:

- ◆ Collect objects of different shapes for children to touch, sort, and match
- ◆ Provide containers for putting in and taking out objects
- ◆ Create space for block play and other types of building
- ◆ Plan a variety of experiences for babies and toddlers to move their bodies through space

### Language

As infants and toddlers begin to learn language, adults can support both their concept and vocabulary development through interactions and conversations. Follow the child's lead to make words and ideas meaningful and contextualized. Take advantage of opportunities to use descriptive language related to shapes and their properties and spatial relations.

#### For example, adults can talk about:

- ◆ Positions of objects or people (e.g., "She's *next to* the tree." or "He's stepping *up*." or "We're both *on top of* the rectangle!" or "Let's put them in a straight line.")
- ◆ Shapes and their attributes (e.g., "Your ball is round and smooth." or "You're standing on a red rectangle! Mine's blue." or "Let's all hold hands and make a big circle.")

### Materials to Support Geometry and Spatial Sense Exploration

- ◆ Containers of different shapes and sizes
- ◆ Objects, like blocks, that are easy-to-grasp
- ◆ Clean, recycled plastic lids
- ◆ Large boxes to play in and with
- ◆ Outdoor, gross motor toys (tricycles, climbing toys)
- ◆ Puzzles and shape sorters
- ◆ Picture books





## Adult Support for Infant and Toddler Development of Geometry and Spatial Sense Concepts



*Look for and listen to Geometry and Spatial Sense experiences and interactions in Early Head Start Programs*



Infant/Toddler Center-Based Classrooms and Family Child Care Homes	Infant/Toddler Home-Based Option
Juan and Teacher are sitting next to a bin of foam shapes. Juan picks up a shape and says, "Red ball." Teacher says, "Yes, your ball <i>is</i> red. And round and smooth. Can you roll the ball to me, Juan?" He pushes the ball forward.	The home visitor, 4-year-old Mario, and Mario's parent make shapes with their fingers and hands. Then they peek through them at each other saying "I'm a triangle!" or "I'm a circle!" Two-year-old Isabel attempts to copy Mario and baby Gita giggles.
After awakening in her crib, Mary reaches up toward the shape mobile hanging from the ceiling. She watches the shapes slowly rotate and spin in the air.	During a group socialization, children and families make a line and follow the leader around the room, turning and moving. The teacher gives instructions, such as "move forward", "step back", "around in a circle" until parents join in with their ideas.
Throughout the day, Teacher emphasizes shape and form in her questions and comments such as, "We've got round crackers and square crackers." and "Do you want the triangle puzzle?" and "Hold hands to make a circle!"	The home visitor reads <i>Going on a Bear Hunt</i> , emphasizing the concepts under, over, around, and through. Twins Charise and Shawnte and their mother change the chant to "Going on a Shape Hunt" and march around the house chanting and finding shapes.
Toddlers Atiyah, Juan, and Misty run under the triangle-shaped "bridge" made by two teachers' bodies and arms as they all sing "London Bridge Is Falling Down."	Terry's family tells the home visitor they invented a game called "Where are you now?" First, Terry hides, and they call out, "Where are you now?" He responds, "Couch." The parents add a little more by saying, "You're <i>behind</i> the couch?"



## Preschool Development

This section focuses on preschoolers' developing geometry and spatial sense knowledge. First, read about the general progression of preschoolers' understanding of geometric and spatial concepts. Then, consider the ways in which classroom teaching staff, child care staff, and families can support learning in this math area.

Children's knowledge and language about shapes and spatial relations undergoes considerable development during the preschool years.

Preschoolers become increasingly aware of the similarities and differences between shapes as they create and use shapes in constructions, drawings, and puzzles. They compare and match shapes and fit them together with growing accuracy.

They also learn to recognize and name many common shapes. They learn about the attributes of shapes and begin to describe shapes based on these attributes—"It has three sides, so I know it's a triangle."

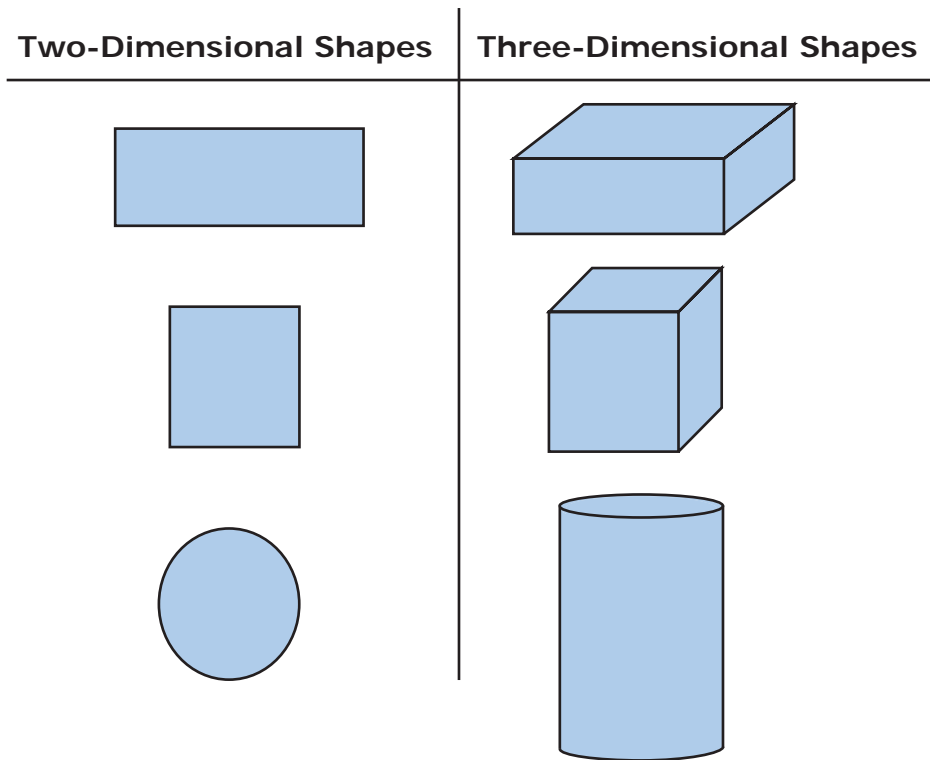
Preschoolers continue to explore and develop concepts about spatial relations, such as position, order, and directionality. Their spatial concepts and language become increasingly sophisticated.

Young children's development in these areas is supported by moving their bodies through space, having a wide variety of experiences with two-dimensional and three-dimensional shapes, and rich adult interactions.



## Two- and Three-Dimensional Shapes

Preschoolers usually hear and learn the names of 2-D shapes first. They may also start identifying 3-D shapes by their two-dimensional name (pointing to a cylinder and calling it “that circle thing” (Ginsburg, et. al, 2003). When teaching staff know and use the correct names for both 2-D and 3-D shapes it encourages children to learn the shape names, too. Beyond simply naming shapes, it’s important to have conversations with children about the attributes/characteristics of 2- and 3-D shapes. For example, when playing with blocks a child might point and ask for “that square thing.” Staff can respond by adding a little more, “The cube? The one with squares on all the sides?”



2-D shapes have height and width, but no depth. Examples are rectangles, squares, circles, and triangles. 3-D shapes have height, width, *and* depth. They have faces, edges, and corners (or vertices). Examples include spheres, cubes, and prisms.



### Geometric and Shape Attributes

- ◆ Length of sides
- ◆ Number of sides
- ◆ Size of angles
- ◆ Number of angles
- ◆ Two versus three dimensions
- ◆ Curved or straight lines
- ◆ Diameter, radius, and circumference for curvilinear shapes, like circles or spheres

## Recognizing and Naming Shapes

During the preschool years, children's ability to recognize and name shapes starts out fairly rigid. For example, young preschoolers often say a shape is not a triangle unless it has three equal sides and is in the familiar orientation with its point up. With experience, their shape concepts become progressively more flexible and analytical as they learn about attributes of shapes (Clements & Battista, 1992; van Heile, 1986). For example, they know that a shape is a triangle if it has three sides and three corners, even if it's "upside down".

### Preschoolers:

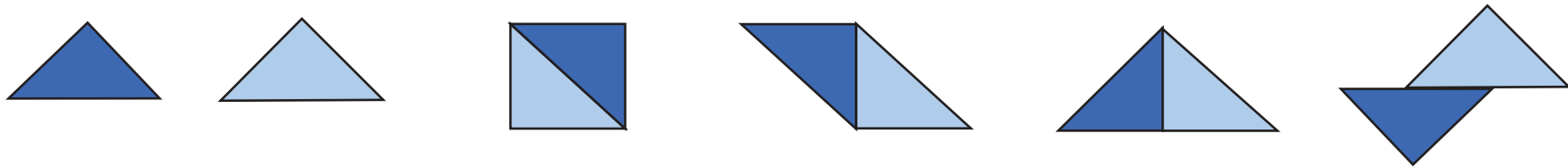
- ♦ First, know the names of some common shapes, but often relate shapes to everyday objects (e.g., calling a circle a ball)
- ♦ Then, identify and name basic shapes that they commonly see, like circles, squares, and equilateral triangles
- ♦ Finally, begin to identify shapes in different orientations and describe shapes based on their attributes, for example, number of sides or the lengths of sides (Clements & Battista, 1992; van Heile, 1986)





## Manipulating Shapes

Preschoolers use their developing knowledge about shapes and the attributes of shapes when they build with blocks, draw, and work puzzles. These types of experiences require children to compare and match shapes, reorient shapes by rotating, flipping, or sliding them, and put shapes together to make new shapes. For example, two isosceles triangles can be flipped and rotated to form a square, a parallelogram, a larger triangle, and other irregular shapes.



As children develop and gain experience using and manipulating shapes, like the paper shapes in the photo below, they move from a trial and error approach to more deliberate, planned actions (Clements, Wilson, & Sarama, 2004). For example, often older toddlers and younger preschoolers try, even *force*, puzzle pieces where they do not fit. Older preschoolers can begin to use their growing understanding of shapes and spatial relations to manipulate shapes more efficiently and accurately. For example, they can think about where a puzzle piece might go and how it should be oriented before placing it.

### Preschoolers:

- ◆ Compare and match shapes
- ◆ Compose and decompose shapes (take them apart and put them together)
- ◆ Move and reorient shapes (flip, rotate, slide)
- ◆ Use language, like “on”, “under”, and “next to” to describe the location of objects





## Moving Ones Body Through Space

One critically important way that young children develop spatial sense (understanding of directionality, position, and order) is by moving their bodies around their environment. Finger plays, dancing, and other gross-motor play, as well as games like hide-and-seek or hopscotch promote spatial sense development.



**The Family Child Care Program Option**

Family child care homes often include children of a variety of ages. Help family child care teaching staff brainstorm and understand experiences that support spatial concepts for a range of ages. For example, reaching and grasping require young children to manipulate objects using their sense of position, order, and directionality.

- ◆ Babies can be encouraged to reach for and grasp a rattle, objects on a mobile, their bottle, or a pacifier
- ◆ Toddlers can use stacking and nesting toys
- ◆ Preschoolers can play games where they reach and grasp to pass toys from one child to the next (like playing catch or "Hot Potato")

### Preschoolers:

- ◆ Gain control over their body movements through experiences like running, jumping, and climbing
- ◆ Improve their motor skills and coordination when they have music and movement experiences like dancing or doing finger plays, like "Head, Shoulders, Knees and Toes"
- ◆ Become more accurate and deliberate in their spatial judgment and reasoning (Clements, Wilson, & Sarama, 2004)
- ◆ Can begin to use representations of the environment, like simple maps or models, to locate hidden objects (Huttenlocher, et al., 1999, 2008)

## Moving Objects Through Space

Another way children learn about spatial concepts is by moving or reorienting objects from one place or position to another. Playing with and manipulating objects, toys, and shapes highlight the strong relationship between spatial sense and geometry; geometric attributes of an object *define* how and where it fits in the environment. The traditional wisdom, "*You can't fit a square peg in a round hole,*" perfectly illustrates how a shape's attributes dictate where it will, and will not, fit.

### For example, preschoolers:

- ◆ Flip, rotate, and slide objects like puzzle pieces and building blocks
- ◆ Begin building block structures with complex enclosures representing space like the inside and outside of a house (Reifel, 1984)
- ◆ Organize materials that come in different shapes and sizes (such as measuring cups and dishes)
- ◆ Play games that require eye-hand coordination such as catch
- ◆ Learn and use more complex vocabulary to describe location, like "behind" (Internicola & Weist, 2003)



## The Language-Concept Connection

The development of spatial concepts and use of spatial vocabulary are strongly interrelated (Internicola & Weist, 2003).

- ◆ Young children first understand simple spatial relations, and begin using the words that describe them, such as *in, on, under, up, into, onto, out of, off*
- ◆ Later they begin to understand more complex concepts and use spatial language such as *across, along, around, through, behind, in front of, between*



## Adult Support for Preschoolers' Development of Geometry and Spatial Sense Concepts



### Materials, Environments, Experiences, and Language

Adults play a critical role in helping children develop knowledge about geometry and spatial sense. It is important for teaching staff, families, and caregivers to provide a variety of experiences and to frequently use language that describes shapes and spatial relations.

#### For example, adults can:

- ◆ Help children notice attributes of shapes such as number of sides and corners, curved versus straight lines, etc.
- ◆ Provide examples of 2-D shapes that are irregular or in different orientations so children expand their thinking about shapes
- ◆ Provide opportunities to put together and take apart different shapes
- ◆ Plan experiences that encourage children to move their bodies through space in a variety of ways (obstacle courses, acting like different animals, visiting a playground, "Going on A Bear Hunt", etc.)



*"I'm going to put my triangle on top of yours to see if they are the same."*

#### For example, adults can talk with children about:

- ◆ Similarities and differences between 2- and 3-D shapes
- ◆ How they figure out where pieces fit as they play with puzzles or blocks
- ◆ What they are doing and where things are, using descriptive language like "down the slide", "through the tunnel", "on top", and "behind the tree"

*Geometry-rich learning environments should include "varied examples... [of shapes], discussions about shapes and their attributes, a wider variety of shape classes, and a broad array of geometric tasks."*

- Clements & Sarama, 2009, p133

## Adults Support for Preschoolers' Development of Geometry and Spatial Sense Concepts



***Look for and listen to Geometry and Spatial Sense experiences and interactions in Head Start Programs***



Preschool Center-Based Classrooms and Family Child Care Homes	Preschool Home-Based Option Family Settings
It is Bobby's turn to place a parent handout on geometry, "Learning About Shapes", in each child's cubby to be taken home. As he does so, Teacher asks if he remembers yesterday's shape-hunt.	The home visitor, mom, and preschooler Lucas fold napkins to set the table for an early dinner. They fold the square napkins into different shapes like rectangles and triangles. The three talk about how neat it is that square napkins can turn into so many other shapes with a simple fold or two!
In the family child care home, Teacher turns on the CD player and "Tingaleo" begins to play. Children begin to dance. Tameka and Joy get down on all fours and pretend to be the little donkey, Tingaleo. Others dance, being careful, not always successfully, to not bump into anything.	The home visitor and Mimi's parent discuss various ways to make shapes. Her parent recalls playing the string game, "Cat's Cradle", during childhood and wonders if she could teach a simple version to her child and talk about the shapes they create.
In the family child care home backyard, Teacher chalks a hopscotch game with triangles, squares, and rectangles on the cement walkway. Harry and Tameka hop in and out of the shapes, while Armando prefers to use the chalk to draw his own representations in his own space.	The home visitor, parent, and Terry decorate a "Search Box" made out of a shoe box. Terry's parent hides a foam shape in it. Terry reaches in, feels the shape, and describes it. Then Terry puts a shape in the box for the home visitor, who describes the shape (edges, corners) before she guesses a rectangular prism.
During small group time, Teacher hands a different sized cardboard rectangle to each child. Teacher asks Tina, TJ, and Bobby to trace their fingers around their shape. Teacher encourages them to chant as they trace; "Side....., corner, side....., corner, side....., corner, side....."	Preschoolers Mario and Isabel get help from mom and the home visitor to make a ball out of old, mismatched socks and masking tape. When they each have a sock-ball, including baby Gita, Mario and Isabel and the home visitor go outside to throw the ball to each other. Gita sits in her mother's lap and pats the ball in her mother's hand.



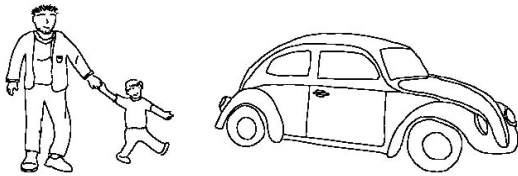


## Language is Key—Birth to Five

Here are two Geometry and Spatial Sense scenarios featuring the *Follow the CAR* dialogic strategies. The strategies require adults to follow the child's lead and give the child time to talk. This encourages longer, richer conversations about children's interests and is a perfect opportunity to mathematize children's experiences.



### Follow the CAR



#### Follow the child's lead and then:

- ⇒ Comment and wait, or
- ⇒ Ask question and wait, or
- ⇒ Respond by adding a little more and wait, or
- ⇒ When speaking in the home language and a child says a word in English, repeat the word in the home language

*Language Is the Key—Follow the CAR* is a multimedia resource distributed by the National Head Start Family Literacy Center. If your program does not have the book and DVD already, email [info@wlearning.com](mailto:info@wlearning.com).

### INFANT/TODDLER SCENARIO

Home Visitor Lan arrives at the Nguyen house. Lan uses math language in the context of experiences that are safe for both children.

(FOLLOW) As the family sits together, toddler Mai leans toward infant Thanh on her mother's lap and says, "Boo!" She says, "Boo!!!" louder and bumps her head onto Thanh's head. Lan recognizes Mai's approach in getting her brother's attention could hurt Thanh.

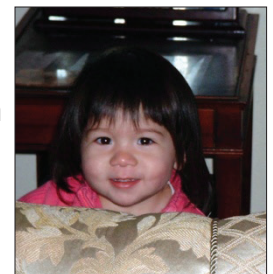
(COMMENT) "I think Thanh will watch you if you play Peek-a-Boo from behind the couch," Lan says to Mai. She helps Mai squat down. Mai eagerly says "boo" but does not jump up.

(ASK) "Can Thanh see you behind the couch?" asks Lan. Mai thinks for a moment and answers, "No," and starts jumping up when she says boo.

(COMMENT) As Mai repeats the game again and again, Lan makes short comments such as "Down!" , "Up!", and "Mai is behind the couch." She pauses after each comment to give Mai a chance to respond.

(RESPOND) Mai points to her brother and says, "Thanh smile!" "Yes!" responds Lan, addressing the whole family. "His eyes light up and he gets excited when he sees and hears Mai."

(FOLLOW) They continue to play until Mai gets bored. Both parents occasionally make comments to Mai and watch Thanh respond. "That's a nice, safe way they can play together," says Lan. "It is a chance to use math—position and location—words."



## PRESCHOOL SCENARIO

The family childcare children gather together for lunch. Each child has a personalized placemat with shapes on it. Teacher Anna sits down with all the children at the low table.

(COMMENT) Teacher Anna comments that everyone has their placemats. "I do," responds Elisabeth. "See mine?" "Yes," responds Teacher Anna, "with squares on it."

(RESPOND) Andrew says, "Mine's circles." As other children call out the shape names, Teacher Anna follows their lead, responding about the number of sides each shape has and encouraging children to trace around their shapes with a finger.

(ASK) As the conversation slows down, Teacher Anna extends the discussion with a question. "What shape is your favorite food?" Lucas replies immediately, "Oranges! They're circles!"

(RESPOND) "Oranges *are* round like circles," says Anna. As the children continue eating, Anna pauses to see if anyone will talk more about oranges, circles, or spheres. Teacher Anna notices Andrew looking at the circle on his placemat.

(ASK) "How is an orange different than the circle on your placemat, Andrew?" Andrew thinks for a long while. "You can hold an orange," he finally responds.

(RESPOND) Teacher Anna laughs warmly at his thoughtful reply. "Round things you can hold, like oranges and soccer balls, can be called spheres."

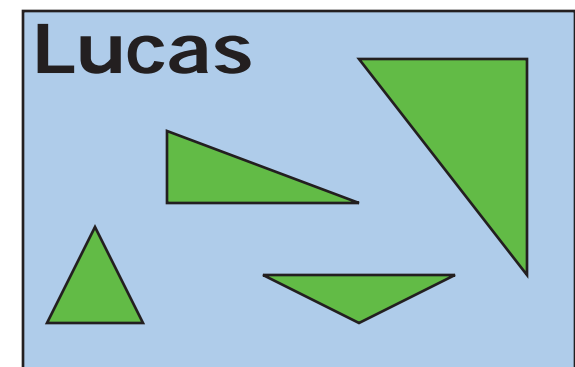
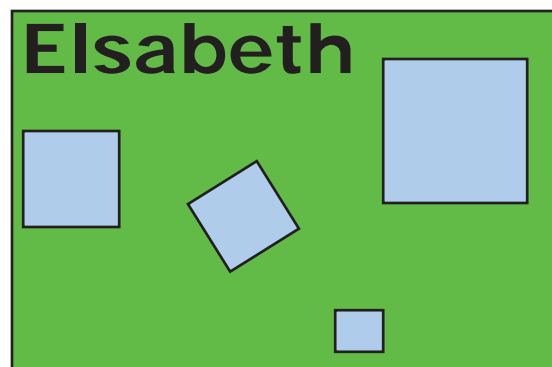
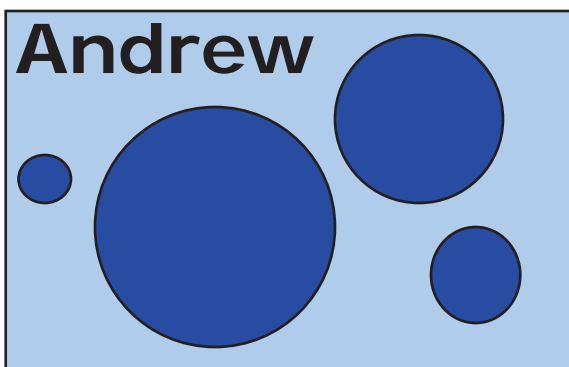


### Follow the CAR



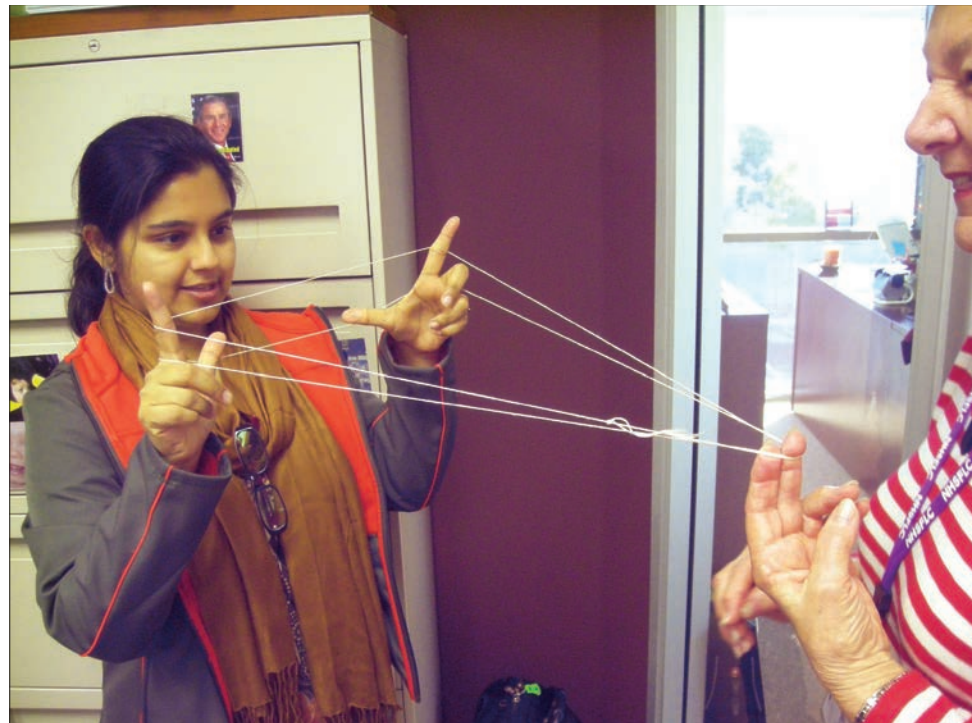
#### Follow the child's lead and then:

- ⇒ Comment and wait, or
- ⇒ Ask question and wait, or
- ⇒ Respond by adding a little more and wait, or
- ⇒ When speaking in the home language and a child says a word in English, repeat the word in the home language





## Ongoing Monitoring, Supervision, and Professional Development



## Introduction

This section is designed to help you ensure that Head Start and Early Head Start programs provide high quality experiences and individualized instruction related to Geometry and Spatial Sense. The first step in this process is to gather information about your program through observation, self-assessment, ongoing monitoring, and child-outcomes data. Next, educational leaders need to analyze the information collected to determine program-wide, as well as individual teaching staffs' needs. Finally, decisions must be made about the training or supervisory approaches best suited to the needs, culture, strengths, and learning styles of your staff.



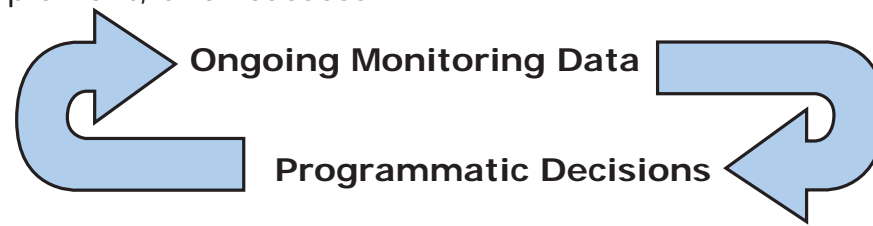
### The following pages contain resources about:

- ◆ Data collection through ongoing monitoring, classroom observation, program self-assessment
- ◆ Mentoring and reflective supervision to support reflective practice and professional development
- ◆ Ongoing support of infant, toddler, and preschool children's development in the area of Geometry and Spatial Sense
- ◆ Professional development tools to support staff in center-based, family child care, and home-based program options



## Using Data from Ongoing Monitoring to Make Decisions

Head Start and Early Head Start programs face the ongoing task of making decisions—both small and large—to ensure positive outcomes for children. Answers to challenges may surface quickly and be easily put into practice. Other times a more thorough approach is needed to define a problem, decide upon a solution, and plan for implementation, implement, and reassess.



The High Five Mathematize Guide is meant to help Head Start and Early Head Start leaders to 1) become more familiar with child development in the area of mathematics, 2) find out about the math strengths and needs of children and program staff, and 3) provide professional development tools to meet those needs and capitalize on existing strengths.

The following page provides four categories with questions to help organize an approach to decision-making about math teaching and learning. The categories are:

- ◆ Staff Behaviors and Teaching Practices
- ◆ Learning Environments and Materials
- ◆ Child Behaviors
- ◆ The School-Home Connection

In addition to this guide, there are dozens of Program Planning resources on the Early Childhood Learning and Knowledge Center (ECLKC) website at <http://eclkc.ohs.acf.hhs.gov>, as well as observation tools such as those listed to the right.

### Tools to Guide Observation and Monitoring

1. SOLAR Infant/Toddler Classroom Staff Skill Profile (See Appendix)
2. OHS Math Environmental Scan (See Appendix)
3. OHS Math Geometry and Spatial Sense Webcast #3
4. OHS Monitoring Protocol: Education and Early Childhood Development

## Using Data from Monitoring Systems to Make Decisions

Ongoing monitoring, classroom and staff observations, and even informal classroom visits, provide opportunities to look for behaviors and environmental factors that support positive outcomes for children.

### Staff Behaviors and Teaching Practices

- ◆ How do staff create learning experiences and environments that expose children to a variety of geometric shapes and concepts?
- ◆ How do planned and spontaneous conversations respond to children's questions and interest and foster vocabulary growth related to shapes and spatial sense?
- ◆ Do staff use "math talk" or otherwise mathematize children's everyday moments to highlight shapes and spatial concepts?
- ◆ How do staff involve families in geometry and spatial sense experiences?

### Learning Environments and Materials

- ◆ Are there a variety of materials—indoors and outdoors—that encourage children to manipulate and learn about 2- and 3-D shapes?
- ◆ How does the environment encourage children to explore location, position, and directionality as they move their bodies, and other objects, through a variety of spaces?

### Child Behaviors

- ◆ How are children engaging in and talking about: block play, constructing with a variety of materials, comparing different shapes, and locations and positions of themselves or objects around them?
- ◆ How does the ongoing observation and child assessment information inform teaching staff's planning?



This teacher talks with the little girl about the shapes and sizes in her circular rainbow.

### The Home-School Connection

- ◆ Is information shared with families about how to support geometry and spatial sense at home?
- ◆ Is math a part of family-education or parent meetings?
- ◆ Are families encouraged to think of themselves as mathematicians in the course of their daily lives and empowered to help their children learn?

## Mentor Coaching and Reflective Supervision

Mentor-coaching and reflective supervision help teaching and home visiting staff improve their professional practice. The mentor-coaching skills in the boxed-list are not specific to Geometry and Spatial Sense, or any other area. They are general skills for supervisors and mentors to consider and employ. Read how these skills can support staff and, ultimately, result in positive Geometry and Spatial Sense outcomes for children.

*An Education Manager wants to encourage more “math talk”. Based on outcomes data, she will start with language and vocabulary about spatial sense (position, location, direction). She plans to ask staff to “find the spatial sense” words and concepts in children’s books.*

Staff watch the OHS Webcast #3 about Geometry and Spatial Sense and answer the following questions on their own. Then teaching teams discuss their responses.

- ◆ What were the key messages?
- ◆ How will I use this information with children/families?
- ◆ What support or resources would help me learn more?

*Teachers are asked to take pictures and complete written observations of children in the block area. The observations and photos are used in the next in-service. The in-service focuses on how to use children’s rich experiences in the block area to assess and plan for geometry and spatial sense.*

A home visitor realizes, while talking with her mentor-coach, that she’s not sure how to share child development information related to geometry and spatial sense with a dual language family. The two discuss ways to best meet the family’s needs.

### Mentor-Coaching Skills\*

- ◆ Professional Development Planning
- ◆ Setting Achievable Goals
- ◆ Problem Solving
  
- ◆ Relationship Building
- ◆ Sharing Values
- ◆ Culturally Sensitive Approaches
- ◆ Self-Reflection
- ◆ Communication, Listening, and Reflective Inquiry
  
- ◆ Observation and Use of Observation Tools
- ◆ Reflective Conferencing
- ◆ Journaling
- ◆ Providing and Receiving Feedback
  
- ◆ Child Assessment
- ◆ Individualizing Instruction

\*See Appendix for additional resources about Mentor-Coaching.

## Self-Assessment for Early Head Start Staff

This self-assessment\* can be completed by Education Managers, supervisors, and/or teaching staff.

The information can then be used, in a non-evaluative way, to make decisions about topics for program-wide training or used on an individual level with staff to provide tailored mentor-coaching or reflective supervision.

Insight from the self-assessment may also help staff identify their own professional development goals.

Page ahead to find additional self-assessments to use with Head Start staff and home-based staff.

*\*See the end of the chapter for full-size versions of the Geometry and Spatial Sense Self-Assessments.*

Skills for Adults Working with Children Birth-3 Years of Age	Geometry and Spatial Sense				
	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
I know how our program's infant and toddler curriculum and assessment tools address shape (geometry) and spatial sense.	1	2	3	4	5
I understand what to expect infants and toddlers to know and be able to do related to manipulating and talking about shapes.	1	2	3	4	5
I develop and write teaching plans to engage babies and toddlers in multi-sensory experiences that support their developing spatial sense.	1	2	3	4	5
I provide a variety of materials, manipulatives, and objects to support learning about shapes and spatial relationships (location, position).	1	2	3	4	5
I know about and use resources to support children's developing knowledge and skills related to geometry, shapes, and spatial sense.	1	2	3	4	5
I mathematize or find the shapes or spatial sense in infants' and toddlers' daily routines and interactions.	1	2	3	4	5
I provide families with information about shape and spatial sense experiences and vocabulary to use at home.	1	2	3	4	5



## Professional Development

### Ideas for Staff Working with Infants and Toddlers

**Mathematize** means to bring out, or highlight, math concepts during an interaction with a child or group of children.

Adults mathematize in a variety of ways, but the first step in mathematizing is to recognize math concepts embedded in what children are exploring or experiencing.

The one-page Spatial Sense handout\* (right) is designed to help Early Head Start teaching staff and home visitors (and even families!) to describe position, location, and directionality. You may choose to provide a scaffold (like the list below), depending on the needs of the participants.

Make sure there is time to discuss the handout and how it supports the work EHS staff do with children and families.

#### Examples of Spatial Sense Words

- |         |               |                 |
|---------|---------------|-----------------|
| ◆ In    | ◆ Around      | ◆ Top           |
| ◆ Out   | ◆ In front of | ◆ Bottom        |
| ◆ On    | ◆ Behind      | ◆ Near          |
| ◆ Under | ◆ Next to     | ◆ Far           |
| ◆ Up    | ◆ Beside      | ◆ First, Second |
| ◆ Down  | ◆ Between     | ◆ Last          |
| ◆ Above | ◆ Through     | ◆ Next          |
| ◆ Below | ◆ Inside      |                 |
| ◆ Over  | ◆ Outside     |                 |

#### Spatial Sense: Position, Order and Directionality

##### Spatial Words

- 
- 
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Use the three pictures below to help make a list of spatial sense words and concepts. Words about the position and location of the baby, the baby's body, the baby's toys, or the adult caregiver all describe spatial concepts.



\*A reproducible, full-size photomontage is at the end of the chapter.

## Professional Development

### Ideas for Staff Working With Infants and Toddlers

Another excellent training approach is to have staff analyze and discuss video clips of children in action. Two infant/toddler video clips are located on your High Five Mathematize DVD in the Geometry and Spatial Sense folder and are called First Encounter and Shape Sorter. Use the videos for small or large group trainings or with families or guardians during family meetings.



#### First Encounter

Before watching the clip of 10-week-old Brayden, brainstorm and discuss the types of behaviors one would expect when an infant encounters a new object. You may want to watch the video more than once.

Use questions such as the following to facilitate the discussion.

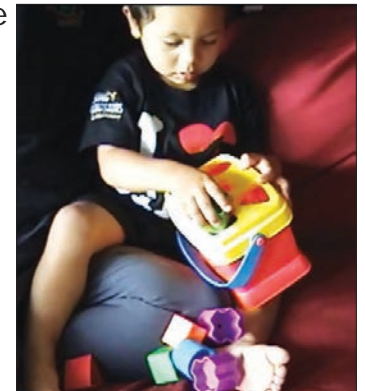
- ♦ What did you notice?
- ♦ How might you describe Brayden's developmental level/abilities to his mother?
- ♦ How does this interaction between the mother, infant, and object support his newly forming concepts of space and geometry?

#### Shape Sorter

Before watching the clip of 2-year-old Lucas, have your audience brainstorm and discuss the skills involved in playing with a shape sorter. Help staff focus on geometry and spatial sense skills (e.g., coordinating the position of the shape with the hole, matching attributes—the size and shape of hole and the size and shape of the object, etc.). Then watch the clip. You may want to watch the video more than once.

Use questions such as the following to facilitate the discussion.

- ♦ What did you notice?
- ♦ How would you describe Lucas' abilities? What understanding of geometry and spatial sense does he demonstrate? What is he still learning?
- ♦ What additional support, scaffolding, or "math talk" could help Lucas?



## Professional Development

### Ideas for Staff Working With Infants and Toddlers

KWL was developed as a reading instructional strategy (Ogle, 1996).

“K” stands for ***what I know***,

“W” stands for ***what I want to know***, and

“L” stands for ***what I learned***.

Try this Geometry and Spatial Sense KWL Worksheet\* with Early Head Start home visitors and teaching staff over the course of *two* planned in-services or staff meetings or revise it to any relevant topic.

Introduce the KWL approach, have staff complete the K and W columns of the chart, and discuss responses. Between the first and second meeting, staff search for and use resources to check their knowledge (K column), find answers to their questions (W column), and write about what they learned (L column). Encourage staff to seek information in class or program resources, like textbooks, early childhood journals, NAEYC publications, curriculum and assessment guides, or state Pre-K guidelines.

At the next meeting, staff share their discoveries, remaining questions, and implications for their work with infants, toddlers, and families.

### Geometry and Spatial Sense KWL Worksheet Learning Objectives

Participants will:

1. Reconsider infant and toddler development related to geometry and spatial sense
2. Identify and use available resources in the program
3. Reflect on their own knowledge, questions, and learning
4. Share information, experiences, and insights with their colleagues

### Geometry & Spatial Sense KWL Worksheet

Fill in the K and W of the KWL chart with as many ideas as you can. Then, take time to hunt for information in your program resources (curriculum guides, text or resource books, Zero to Three journals, EHSNRC, etc.). Come back to the KWL chart and write what you learned in the L column. Also, look for information needing correction or revision in the K column. .

<b>K</b> What I <b>KNOW</b> about infant and toddler geometry and spatial sense development.	<b>W</b> What I <b>WANT</b> to know or learn more about infant and toddler geometry and spatial sense development.	<b>L</b> What I <b>LEARNED</b> about infant and toddler geometry and spatial sense development.

\*A full-size handout is located at the end of this chapter.

## Self-Assessment for Head Start Staff

This self-assessment\* can be completed by Education Managers, supervisors, and/or teaching staff.

This non-evaluative assessment information can assist in decision-making about professional development for all staff meetings, site-based trainings, in-service and pre-service, or individual staff.

*\*See the end of the chapter for full-size versions of the Geometry and Spatial Sense Self-Assessments.*

Skills for Adults Working with Children 3-5 years of age	Geometry and Spatial Sense				
	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
I know key indicators related to Geometry and Spatial Sense.	1	2	3	4	5
I understand what to expect children ages 3-5 to know and be able to do related to geometry, shapes, and spatial relations.	1	2	3	4	5
I use and write teaching plans that engage preschoolers in developmentally appropriate geometry and spatial experiences.	1	2	3	4	5
I mathematize or find the geometry and spatial sense in preschooler's daily routines and interactions.	1	2	3	4	5
I recognize and support emerging skills as children sort by, compare, and describe attributes (e.g., shape or color).	1	2	3	4	5
I use, and encourage children to use, language to describe directionality, order, and position of objects (especially related to children's own bodies).	1	2	3	4	5
I provide families with information and experiences related to geometry and spatial sense to do at home.	1	2	3	4	5
I know where to find resources about children's developing knowledge and skills related to geometry/spatial sense.	1	2	3	4	5



## Professional Development

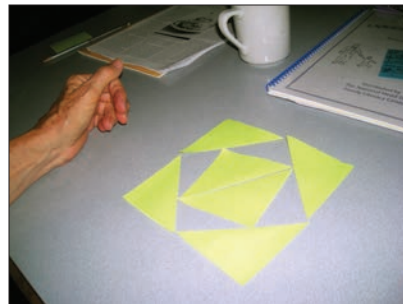
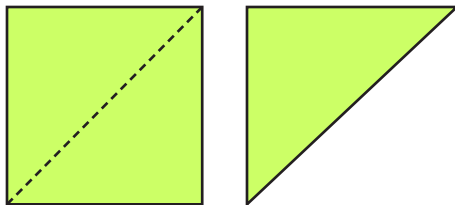
### Ideas for Staff Working with Preschoolers

**Mathematize** means to bring out, or highlight, math concepts during an interaction with a child or group of children.

Head Start staff need opportunities to talk and think about geometry and spatial sense concepts and vocabulary. These opportunities, in turn, prepare staff to mathematize and use more “math talk” when they are with children and families.

Here is one approach that Dr. Juanita Copley uses to increase staff knowledge about geometry and spatial sense.

- ♦ Fold 5-10 square sticky-notes into isosceles triangles (see picture below)
- ♦ Then challenge staff to make, name, and describe as many shapes as they can using the paper triangles
- ♦ Provide staff with the shapes handout\* (at right) to support their vocabulary and shape-making efforts
- ♦ Make a list of the
  - ♦ Shapes teachers made
  - ♦ Different ways teachers repositioned and manipulated the triangles (e.g., flip, rotate, slide) as they put together and took apart shapes



### Two- and Three- Dimensional Shapes Attributes and Properties

*This resource is meant as a professional development tool for adult caregivers, not a list of terms for children to know or on which to be assessed. Also, this resource is not a comprehensive list of shapes. There are many more geometric and cultural shapes and symbols in our world.*

2D Shape Attributes	3D Shape Attributes

2D Shapes	
	Circle: A round two-dimensional figure
	Quadrilateral: A closed figure with four straight sides
	Parallelogram: A quadrilateral with opposite sides that are parallel
	Rhombus: A parallelogram with four equal length sides

*The Two- and Three- Dimensional Shapes: Attributes and Properties\* handout (above) is designed to support and increase teachers' knowledge about shapes.*

\* A full-size handout is located at the end of this chapter.

## Professional Development

### Ideas for Staff Working with Preschoolers

*The Promising Practices Teacher-to-Teacher Showcase\** (handout at right), was developed for programs to share best-practices among staff. This professional development approach not only promotes self-reflection, but also requires teaching staff to make connections between their own practice and key Geometry and Spatial Sense Indicators.

Plan or set-aside time to introduce the promising practices handout to staff. When introducing, motivate staff to comb through their memories and past lesson plans to identify a promising approach. They are looking for an activity or experience involving geometry and/or spatial sense that engaged and excited children.

Once each teaching staff member has filled out the form, promising practices can be discussed, collected, compiled, and bound to create a program-wide resource. The resource will be a source of ready-to-use experiences, activities, or approaches for staff.

Try doing the same for other areas of math and create a comprehensive resource for teaching staff.

**Geometry and Spatial Sense**  
**Promising Practices Teacher-to-Teacher Showcase**

Choose an activity, experience, or approach that has really engaged children *and* addressed the OHS Geometry and Spatial Sense Indicators (below). Be as detailed as possible, as this form will be copied and shared with all the teaching staff. Include a photograph or sketch of children involved in the activity or experience, if possible.

**Name or Title of Activity/Experience/Approach**

**Materials Needed**

**Learning Environment**  
This experience works best with children (circle one or more): one-on-one    small group  
large group    on home visit    outdoors    other \_\_\_\_\_

**Description**  
How many adults are needed? Time needed? How is the activity or experience set up?  
How do you introduce/engage children? What "math talk" or questions are appropriate?

**Modifications**  
How have you made this game easier or harder to meet the needs of all your children?

**Other Areas of Learning**  
What other areas of learning (e.g., language, social/emotional) are addressed?

**Check the Geometry and Spatial Sense Indicators supported by your best practice:**

- Begins to recognize, describe, compare and name common shapes, their parts and attributes.
- Progresses in ability to put together and take apart shapes.
- Begins to be able to determine whether or not two shapes are the same size and shape.
- Shows growth in matching, sorting, putting in a series and regrouping objects according to one or two attributes such as color, shape or size.
- Builds an increasing understanding of directionality, order and positions of objects, and words such as up, down, over, under, top, bottom, inside, outside, in front and behind.

\* A full-size handout is available at the end of this chapter.

## Professional Development

### Ideas for Staff Working with Preschoolers

OHS Geometry and Spatial Sense Webcast #3 Video Lessons, such as "Block Play" and "Where's the Teddy Bear?", can support teaching staff. The video lessons are all framed by three questions:

- ♦ *What happened before the lesson?*
- ♦ *What's happening during the lesson?*
- ♦ *What will I do after the lesson?*

Each video lesson references the Continuum of Teaching Behaviors, from the *Head Start Leaders Guide to Positive Child Outcomes* (2003, p20). The continuum describes eight teaching behaviors ranging between Nondirective, Mediating, and Directive. Education managers or supervisors may find the continuum useful when viewing the math video lessons, observing staff, or explaining individualization approaches.

### Video Lesson from the OHS Geometry and Spatial Sense Webcast #3



#### "Block Play" Lesson

In this video children are exploring and talking about 3-D blocks with the support of an adult.

After watching the lesson, lead staff in a discussion. Use open ended-questions like "What did you notice?" and "What geometry or spatial sense concepts were children learning about?" and "How did the adult use 'math talk'?"



#### "Where's the Teddy Bear?" Lesson

In this video children try to locate a bear hidden under a plastic cup based on clues that use ordinal and positional words.

Staff can identify and discuss spatial sense vocabulary (position, location, and direction) and concepts involved in this teacher-directed activity.

Along with the full-length Geometry and Spatial Sense Webcast #3, the following video lessons are available on the ECLKC website:

- ♦ Baby and Ball
- ♦ Puppy Search
- ♦ Look, Make, and Fix
- ♦ Where's the Teddy Bear?
- ♦ Rectangular Quilt
- ♦ Finding Rectangles and Circles
- ♦ Transformation
- ♦ Block Play



## Self-Assessment for Home-Based Staff

		Geometry and Spatial Sense				
<p>This self-assessment* can be completed by Education Managers, supervisors, and/or teaching staff.</p> <p>The non-evaluative assessment information can assist in decision-making about professional development for all staff meetings, site-based trainings, or individual staff.</p> <p><i>*See the end of the chapter for full-size versions of the Geometry and Spatial Sense Self-Assessments.</i></p>	Skills for Adults Working with Families and Children in Home-Based Program Option	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
	<b>For Early Head Start:</b> I understand birth-to-three development related to spatial sense and geometry/shapes.	1	2	3	4	5
	<b>For Head Start:</b> I know the key Geometry and Spatial Sense indicators.	1	2	3	4	5
	I help families feel confident in their ability to talk about geometry, shapes, and spatial concepts (position, order, direction) with their children.	1	2	3	4	5
	I model how to find the geometry/spatial concepts in families' daily routines, interactions, and environments.	1	2	3	4	5
	I write and use teaching plans that engage children and families in multi-sensory, geometry and spatial sense experiences.	1	2	3	4	5
	I provide families with information and age-appropriate geometry and spatial sense activities to share with their children.	1	2	3	4	5
	I point-out and discuss materials families have in their home (e.g., kitchen containers, dishes, tile, textiles, etc.) to support geometry and spatial sense.	1	2	3	4	5

## Professional Development

### Ideas for Staff Working in Home-Based Program Option

Head Start and Early Head Start staff who conduct home-visits are in the unique position to support both children and their families simultaneously. Have home visiting staff analyze and discuss if and how they might use the following approaches during a home visit to encourage positive child outcomes in Geometry and Spatial Sense.

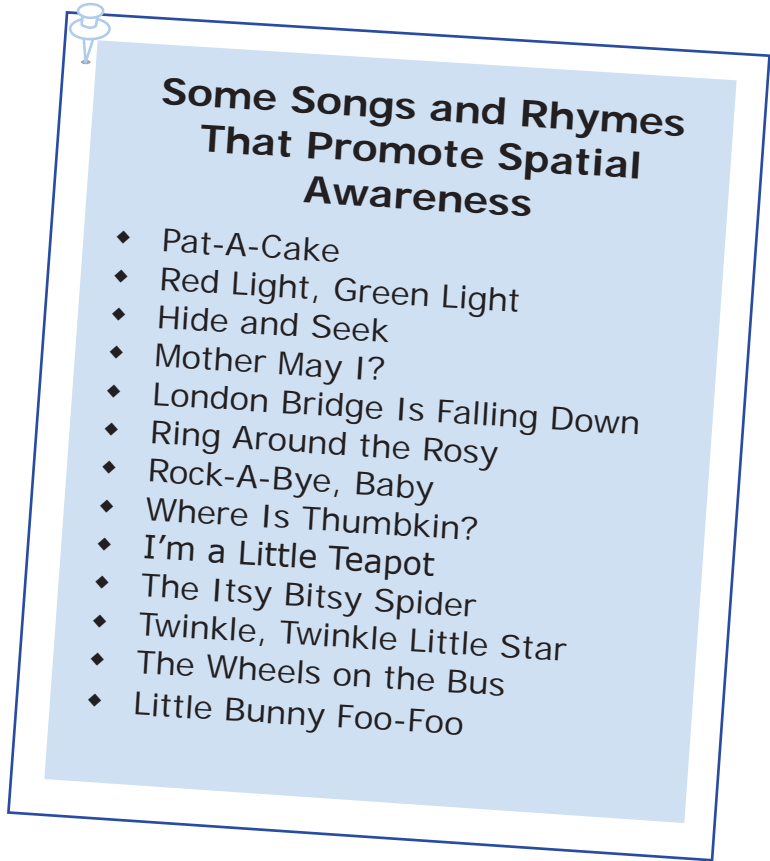
### Support Families' Use of Spatial Language

#### Encourage Songs and Rhymes

- ♦ Home visitors can teach families about the value of songs, rhymes and games, like "Peek-A-Boo" or "The Wheels on the Bus"
- ♦ Discuss how songs, finger plays, and rhymes help children develop a sense of where their bodies are in relation to other people and objects. For example:
  - ♦ The game "Peek-A-Boo" contains spatial concepts of position, location, and directionality, like *open*, *closed*, *behind*, *in front of*, and *hidden*
  - ♦ "London Bridge Is Falling Down" has spatial words or concepts embedded in it, such as *under*, *through*, *around*, *down*, *up*, *side-to-side*, *inside*, and *outside*

#### Play Games like Hide and Seek

- ♦ Play hide and seek during a home visit—indoors or out. Home visitors can model the use of spatial words to describe the position or location of the hidden child or parent:  
"Mommy was *behind* the chair!" or  
"You hid *under* the blankets." or  
"Where is Daddy? Maybe he's hiding *in* the kitchen?"



### Some Songs and Rhymes That Promote Spatial Awareness

- ♦ Pat-A-Cake
- ♦ Red Light, Green Light
- ♦ Hide and Seek
- ♦ Mother May I?
- ♦ London Bridge Is Falling Down
- ♦ Ring Around the Rosy
- ♦ Rock-A-Bye, Baby
- ♦ Where Is Thumbkin?
- ♦ I'm a Little Teapot
- ♦ The Itsy Bitsy Spider
- ♦ Twinkle, Twinkle Little Star
- ♦ The Wheels on the Bus
- ♦ Little Bunny Foo-Foo



## Professional Development

### Ideas for Staff Working in Home-Based Program Option

Home-based programs are in the unique position to simultaneously support children and their families. During a home visit, staff can encourage positive child outcomes in Geometry and Spatial Sense.

The information and photographs below can be used to support staff. It will help them see opportunities in the home or prepare them to highlight geometry and spatial sense relations during home visits. Have home visitors study the photographs on this page. Ask them to list shape and geometry words that come to mind. Also ask what they might say to this little girl to highlight the shapes of the objects in the drawer.

### Shapes and Geometry In the Kitchen

Young children love to be in the kitchen and play with pots and pans, plastic containers, dish towels, and more. Play-based experiences with these containers help children learn about shapes and their attributes.

Shape attributes, or characteristics of shapes include: number of sides, straight or curved edges, length, width, and depth.



### Home visitors can:

- ◆ Help families see the value in playful moments in the kitchen
- ◆ Discuss and model “math talk” related to shapes and geometry (e.g., round, straight, oval, square)
- ◆ Highlight the geometry lessons inherent in the materials (e.g., nesting pots and pans, matching lids and saucers)



## Notes





## Self-Assessment for Early Head Start Staff Geometry and Spatial Sense

Skills for Adults Working with Children Birth-3 Years of Age	I am not skilled in this area	I am somewhat skilled in this area	I am highly skilled in this area
I know how our program's infant and toddler curriculum and assessment tools address shape (geometry) and spatial sense.	1	2	3
I understand what to expect infants and toddlers to know and be able to do related to manipulating and talking about shapes.	1	2	3
I develop and write teaching plans to engage babies and toddlers in multi-sensory experiences that support their developing spatial sense.	1	2	3
I provide a variety of materials, manipulatives, and objects to support learning about shapes and spatial relationships (location, position).	1	2	3
I know about and use resources to support children's developing knowledge and skills related to geometry, shapes, and spatial sense.	1	2	3
I mathematize or find the shapes or spatial sense in infants' and toddlers' daily routines and interactions.	1	2	3
I provide families with information about shape and spatial sense experiences and vocabulary to use at home.	1	2	3

## Spatial Sense: Position, Order and Directionality

Use the three pictures below to help make a list of spatial sense words and concepts. Words about the position and location of the baby, the baby's body, the baby's toys, or the adult caregiver all describe spatial concepts.

### Spatial Words

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# Geometry & Spatial Sense KWL Worksheet

Fill in the K and W of the KWL chart with as many ideas as you can. Then, take time to hunt for information in your program resources (curriculum guides, text or resource books, Zero to Three journals, EHSNRC, etc.). Come back to the KWL chart and write what you learned in the L column. Also, look for information needing correction or revision in the K column.

<b>K</b> What I <b>KNOW</b> about infant and toddler geometry and spatial sense development.	<b>W</b> What I <b>WANT</b> to know or learn more about infant and toddler geometry and spatial sense development.	<b>L</b> What I <b>LEARNED</b> about infant and toddler geometry and spatial sense development.



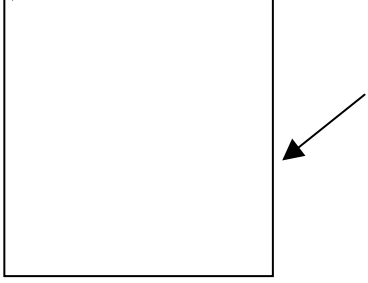
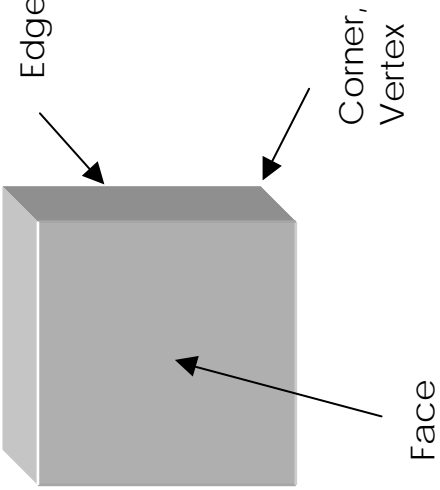


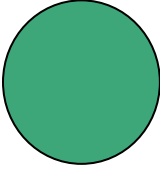
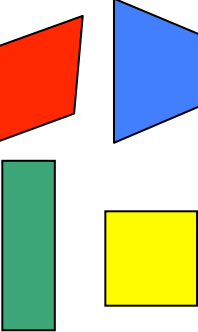
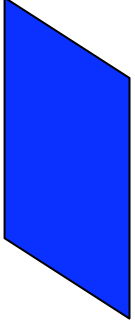
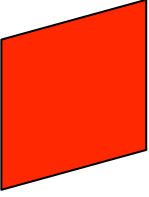
## Self-Assessment for Head Start Staff Geometry and Spatial Sense

<b>Skills for Adults Working with Children 3-5 years of age</b>	<b>I am not skilled in this area</b>	<b>2</b>	<b>I am somewhat skilled in this area</b>	<b>4</b>	<b>I am highly skilled in this area</b>
I know key indicators related to Geometry and Spatial Sense.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I understand what to expect children ages 3-5 to know and be able to do related to geometry, shapes, and spatial relations.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I use and write teaching plans that engage preschoolers in developmentally appropriate geometry and spatial experiences.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I mathematize or find the geometry and spatial sense in preschooler's daily routines and interactions.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I recognize and support emerging skills as children sort by, compare, and describe attributes (e.g., shape or color).	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I use, and encourage children to use, language to describe directionality, order, and position of objects (especially related to children's own bodies).	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I provide families with information and experiences related to geometry and spatial sense to do at home.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I know where to find resources about children's developing knowledge and skills related to geometry/spatial sense.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

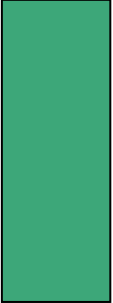
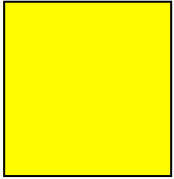
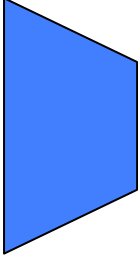
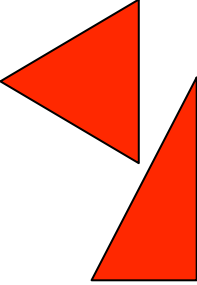
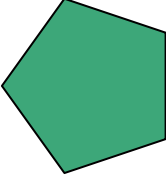
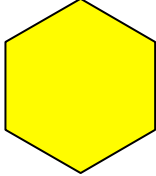
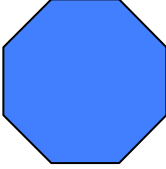
## Two- and Three-Dimensional Shapes Attributes and Properties

This resource is a professional development tool for adult caregivers, not a list of terms for children to know or of concepts on which they should be assessed. Also, this resource is not a comprehensive list of shapes. There are many more geometric and cultural shapes and symbols in our world.

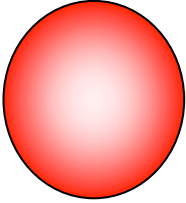
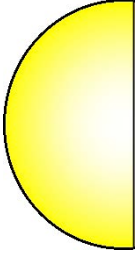
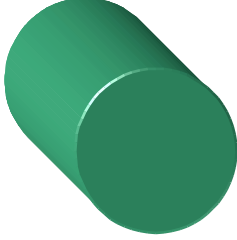
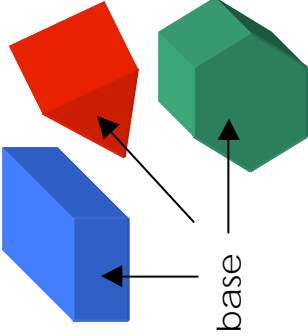

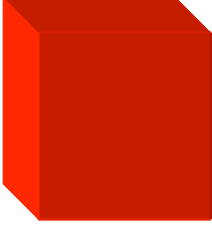
2-D Shape Attributes	3-D Shape Attributes
	

2-D Shapes	
	<p>Circle: A round, two-dimensional figure</p>
	<p>Quadrilateral: A closed figure with four straight sides</p>
	<p>Parallelogram: A quadrilateral with opposite sides that are parallel</p>
	<p>Rhombus: A parallelogram with four equal-length sides</p>

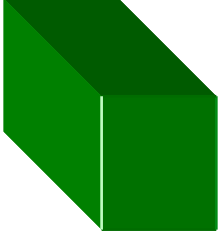
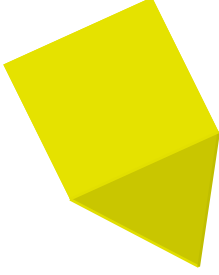
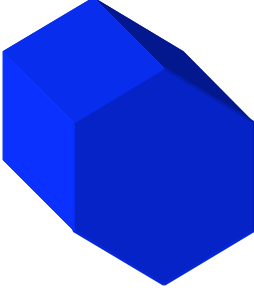
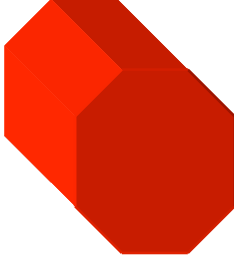
## Two- and Three-Dimensional Shapes Attributes and Properties

	<p>Rectangle: A parallelogram with all right (<math>90^\circ</math>) angles</p>
	<p>Square: A special rectangle with equal-length sides and all right (<math>90^\circ</math>) angles</p>
	<p>Trapezoid: A closed, four-sided figure with only one pair of parallel sides</p>
	<p>Triangle: A closed figure with three straight sides</p>
	<p>Pentagon: A closed figure with five straight sides</p>
	<p>Hexagon: A closed figure with six straight sides</p>
	<p>Octagon: A closed figure with eight straight sides</p>

## Two- and Three-Dimensional Shapes Attributes and Properties

3D Shapes	
	<p>Sphere or Ball: A symmetrical, round, three-dimensional figure</p>
	<p>Hemisphere: Half of a sphere, with a circle for a base</p>
	<p>Cylinder: A figure with two congruent (matching) circular parallel bases. The bases are congruent because they are the same size and shape.</p>
	<p>Prism: A three-dimensional figure, with rectangular faces and two parallel faces, called bases. The shape of the base defines the type of prism. For example, a prism whose bases are triangles is called a triangular prism. The picture also shows a rectangular prism and a hexagonal prism.</p>
	<p>Rectangular Prism: A three-dimensional figure with congruent (matching) rectangular-shaped bases</p>
	<p>Cube: A three-dimensional figure with six congruent (matching) square faces</p>

## Two- and Three-Dimensional Shapes Attributes and Properties

	<p>Square Prism: A three-dimensional figure with congruent (matching) square bases</p>
	<p>Triangular Prism: A three-dimensional figure with congruent (matching) triangular-shaped bases</p>
	<p>Hexagonal Prism: A three-dimensional figure with congruent (matching) hexagonal-shaped bases</p>
	<p>Octagonal Prism: A three-dimensional figure with congruent (matching) octagonal-shaped bases</p>

### References:

Copley, J. V., Jones, C., & Dighe, J. (2007). Mathematics: The creative curriculum approach. Washington, DC: Teaching Strategies, Inc.

Geometry. Retrieved on March 25, 2010, from

<http://www.math.com/homeworkhelp/Geometry.html>



## Geometry and Spatial Sense Promising Practices Teacher-to-Teacher Showcase

Choose an activity, experience, or approach that has really engaged children and addressed the OHS Geometry and Spatial Sense Indicators (below). Be as detailed as possible, as this form will be copied and shared with all the teaching staff. Include a photograph or sketch of children involved in the activity or experience, if possible.

**Name or Title of Activity/Experience/Approach**

**Materials Needed**

**Learning Environment**

This experience works best with children (circle one or more): one-on-one    small group  
 large group    on home visit    outdoors    other \_\_\_\_\_

**Description**

How many adults are needed? Time needed? How is the activity or experience set up?  
 How do you introduce/engage children? What “math talk” or questions are appropriate?

**Modifications**

How have you made this game easier or harder to meet the needs of all your children?

**Other Areas of Learning**

What other areas of learning (e.g., language, social/emotional) are addressed?

**Check the Geometry and Spatial Sense Indicators supported by your best practice:**

- Begins to recognize, describe, compare and name common shapes, their parts and attributes.
- Progresses in ability to put together and take apart shapes.
- Begins to be able to determine whether or not two shapes are the same size and shape.
- Shows growth in matching, sorting, putting in a series and regrouping objects according to one or two attributes such as color, shape or size.
- Builds an increasing understanding of directionality, order and positions of objects, and words such as up, down, over, under, top, bottom, inside, outside, in front and behind.



## Self-Assessment for Home-Based Staff Geometry and Spatial Sense

Skills for Adults Working with Families and Children in Home-Based Program Option	I am not skilled in this area	I am somewhat skilled in this area	I am highly skilled in this area
<b>For Early Head Start:</b> I understand birth-to-three development related to spatial sense and geometry/shapes.	1	2	3
<b>For Head Start:</b> I know key Geometry and Spatial Sense indicators.	1	2	3
I help families feel confident in their ability to talk about geometry, shapes, and spatial concepts (position, order, direction) with their children.	1	2	3
I model how to find the geometry/spatial concepts in families' daily routines, interactions, and environments.	1	2	3
I write and use teaching plans that engage children and families in multi-sensory, geometry and spatial sense experiences.	1	2	3
I provide families with information and age-appropriate geometry and spatial sense activities to share with their children.	1	2	3
I point-out and discuss materials families have in their home (e.g., kitchen containers, dishes, tile, textiles, etc.) to support geometry and spatial sense.	1	2	3





# Patterns

*Quilts and baskets, braided hair.*

*We find patterns everywhere.*

*Clapping, chanting, singing songs;*

*Patterns make our math skills strong.*





# Patterns

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## Introduction

This chapter discusses the ways in which infants, toddlers, and preschoolers learn about patterns and how families, teaching staff, and supervisors support that learning in the classroom and at home. Patterns are regular, predictable arrangements of things. Anything—objects, numbers, shapes, sounds, actions, or events—can make a pattern. Patterns are important in young children’s everyday lives because they provide order and predictability. They help children learn, remember, and anticipate what comes next. Additionally, learning about patterns in the early years sets the stage for a future understanding of algebraic concepts.

Two common types of patterns that are important in early childhood are repeating patterns and growing patterns. Repeating patterns are simply an ordered sequence, such as triangle, square, triangle, square. Growing patterns involve a systematic increase or decrease, usually in number. These types of patterns will be discussed later in this chapter.

Young children begin to learn about patterns in their daily routines, games, songs, and stories. Infants and toddlers experience patterns as they hear and sing songs, listen to simple stories with repeating parts, or rock back and forth in a rocking chair. Preschoolers need opportunities to engage in a variety of experiences with pattern; for example, in music and movement, art, playing with blocks, and stories. Through these experiences, they learn to recognize and reproduce patterns that they hear or see and even create their own patterns.



### Pattern Terms

- ◆ Pattern
- ◆ Attribute
- ◆ Classification
- ◆ Seriation
- ◆ Sequence
- ◆ Repeating pattern
- ◆ Growing pattern

*See Appendix for glossary.*

### Pattern Indicators

- ◆ Enhances abilities to recognize, duplicate, and extend simple patterns using a variety of materials
- ◆ Shows increasing abilities to match, sort, put in a series, and regroup objects according to one or two attributes such as shape or size
- ◆ Begins to make comparisons between several objects based on a single attribute



## Infant and Toddler Development

This section focuses on infants' and toddlers' development of pattern knowledge. First, read about the developmental highlights for infants and toddlers. Then, consider the ways in which classroom teachers, child care teachers, and families can support learning in this area.

Infants' and toddlers' developing knowledge about patterns has its earliest roots with their primary caregivers in simple routines like feeding, diapering, and bedtime. They *thrive* on regularity and predictability and quickly develop expectations about "what will happen next" in daily interactions (Geist, 2009; Sarama & Clements, 2009). In addition, they experience patterns in their play and in the language they hear. Patterns and regularity give infants and toddlers structure within which to learn.

### Infants and Toddlers:

- ◆ Experience patterns in language, play, and routines
- ◆ Delight in repetition, like playing "Peek-A-Boo!" or hearing a familiar song
- ◆ Repeat action sequences *over and over again* in their play like filling and emptying containers
- ◆ Recognize and begin to participate in patterns in stories and songs
- ◆ Notice and learn about attributes of objects such as color, size, shape, and texture
- ◆ Begin to match and compare objects by their attributes; for example, sorting items into color groups, stacking or lining objects up by size





## Adult Support for Infant and Toddler Development of Pattern Concepts



### Materials, Environments, Experiences, and Language

For infants and toddlers, so much learning occurs during daily routines carried out in their everyday environments. When adults are aware of opportunities to help children learn about patterns they are better prepared to mathematize everyday moments, plan activities, and provide appropriate materials to engage young children.

#### For example, adults can:

- ♦ Keep regular routines and schedules so infants and toddlers feel secure and learn what to expect
- ♦ Describe daily events using language like, “After lunch we brush our teeth, change diapers, then take a nap”
- ♦ Highlight and talk about patterns in clothing, pictures, buildings, and nature
- ♦ Describe objects by their characteristics, during play and book reading
- ♦ Sing songs and read stories that use simple, rhythmic patterns, such as *Brown Bear, Brown Bear* by Bill Martin, Jr. or songs like “Five Little Ducks” or “Los Elefantes”
- ♦ Provide materials that can be sorted and differ on only one or two attributes, such as color, size, texture, or shape; soft blocks, large lids, stacking toys, nesting cups, shape sorters, and plastic containers are all appropriate



#### The Home-Based Program Option

Teach home visitors to help each family notice, emphasize, and create patterns in their daily routines. For example, they might tell their children, “You get dressed the same way every day, don’t you? We put on two socks and then two shoes—two socks, two shoes, two socks, two shoes—it repeats!”

If appropriate, home visitors can help parents and children consider other routines as well, such as bedtime, story time, meals, and pick-up-toys time. This will help parents understand how important regular, predictable routine are to children’s development and learning.

*“Mathematics is the science and language of pattern. Thinking about patterns helps children make sense of mathematics.”*

- Copley, 2000, p83

## Adult Support for Infant and Toddler Development of Pattern Concepts



### *Look for and listen to Pattern experiences and interactions in Early Head Start Programs*



Infant/Toddler Center-Based Classrooms and Family Child Care Homes	Home-Based Option Family Settings
<p>The patterns of daily routines are important for babies. Baby Mary's routine is to be fed by Teacher in the rocking chair and then go to sleep almost immediately after drinking her bottle.</p>	<p>The home visitor reads <i>More, More, More Said the Baby</i> by Vera B. Williams with the family. Four-year-old Mario catches on to the repeating phrases and says them with the home visitor. Toddler Isabel points to pictures. Baby Gita bobs her head as the home visitor uses her voice to emphasize the rhythm.</p>
<p>Atiyah and Misty are sitting near each other stringing large beads. Teacher comments, "Atiyah and Misty are stringing beads!" As they look up, she continues, "Atiyah, you picked out all the blue beads. Misty, what colors are you using?"</p>	<p>The twins' mother is braiding Shawnte's hair in rows. Charise watches for a while, and then comments, "Looks like a zigzag! Mommy, mine, too!"</p>
<p>Teacher and her four primary care children are sitting on a rug. She begins to sing "Mary had a Little Lamb". One child sings along, two watch, and the fourth bounces his body to the rhythm.</p>	<p>The home visitor, parent, and Mimi sing songs at the beginning of each visit. Mimi anticipates this and sits herself down on her mother's lap ready to sing her new favorite, "Williby Wallaby Woo".</p>
<p>Billy and Mary laugh as they copy Teacher's made-up verbal pattern, "Ma! Me, me! Mo, mo, mo!" and then, "Ba! Be, be! Bo, bo, bo!" Later they stomp the pattern. <i>Stomp! Stomp, stomp! Stomp, stomp, stomp!</i></p>	<p>The home visitor, parent, and twins Charise and Shawnte find and collect fallen leaves as they go for a walk down the block. When they get home they take out all the green leaves from the pile.</p>



## Preschool Development

This section focuses on preschoolers' development of pattern knowledge. First, read about the general progression of preschoolers' understanding of pattern concepts. Then, consider ways classroom teachers, child care teaching staff, and families can support learning in this math area.

Children enter preschool having already had experience with many patterns in the world around them. Many also enter with an important ability related to patterning: grouping objects by one (or more) attributes. During the preschool years, preschoolers begin to identify patterns in their environment and create their own patterns. They also learn to follow stories and sing songs with more complex repeating and growing patterns. Experience with patterns helps children in other areas of math, including number operations, counting, and problem solving (Copley, 2000).



### Preschoolers:

- ◆ Enjoy singing songs and re-telling stories with repetitive rhythms and words
- ◆ Begin to determine their own rules for sorting and organizing objects
- ◆ Begin to create their own pattern-like designs (Garrick, Threlfall, & Orton, 1999)
- ◆ Begin to identify patterns in their environment
- ◆ Learn to copy simple, repeating patterns (Pieraut–Le Bonniec, 1982)
- ◆ Begin to describe patterns and extend patterns that have been created for them

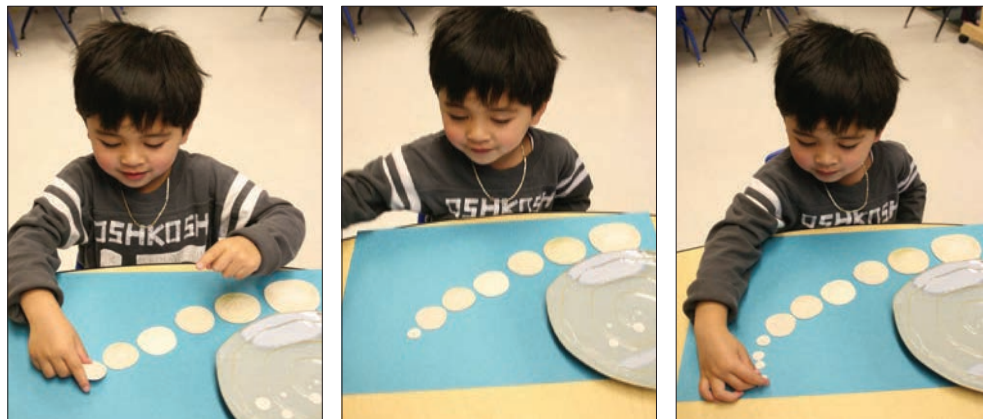


## Classifying and Sorting Objects

Preschool children often classify and sort by grouping and regrouping objects according to one characteristic like color, size, or quantity. Sorting and organizing materials help children focus on attributes, which are necessary for understanding and creating patterns. Patterns are created by arranging objects (or events or sounds) by attributes in a specific, rule-based way. There are many opportunities at home and at school for children to sort and classify. Families and teaching staff can support these simple, enjoyable experiences throughout the day.

Younger preschool children may benefit from extra support when classifying objects. Extra support might include colored bowls that match the counting bears, or labels and pictures on bins to help during clean up time. Materials that differ on only one attribute—such as color, shape, or size—are easiest for young children to classify.

Older preschoolers can create and describe their own rules for classifying things and can sometimes classify by more than one attribute, such as big and little buttons with four holes and big and little buttons with two holes (Inhelder & Piaget, 1969).



### Parent Groups

Use 5 to 10 minutes of each parent meeting to teach parents about math and reduce math anxiety.

- ◆ Explain that sorting and organizing objects is a fun way to help children learn about patterns. Patterns help children to anticipate and to participate in “what comes next”, and is an important area of mathematics.
- ◆ Bring a collection of household items like coins, lids, plastic silverware, and socks. Ask families to sort and organize the materials and then discuss what they did.
- ◆ Encourage families to take opportunities during chores and routines to sort, organize, and talk about the characteristics of everyday objects with their children.

**Seriation**, a type of classifying and patterning, requires objects to be arranged in an increasing or decreasing order. By 3 or 4 years of age, children can create small series of objects differing in size (Sarama & Clements, 2009; Greenes, 1999). The child pictured left put sand dollars in order from largest to smallest. Children can seriate by other attributes, too, such as length (longest to shortest), shades of color, sound (loudest to softest), or weight (heaviest to lightest).

## Recognizing, Extending, and Creating Patterns

Preschoolers are often exposed to repeating patterns like the one below. This type of pattern includes *elements*, the individual units of the pattern. Preschool children can recognize simple repeating patterns such as the ABAB pattern (the red-pink-red-pink pattern below) and extend them by saying what should come next. Older preschoolers can extend more difficult patterns such as ABB or AABB (e.g., red, pink, pink; or red, red, pink, pink). When two or more attributes are used, like color AND shape, the pattern is more complex and more difficult to describe, extend, and create.

Preschoolers are also exposed to a variety of growing (or decreasing) patterns, like the “plus one” pattern in *The Very Hungry Caterpillar* by Eric Carle. See examples below of a simple and a more complex growing pattern.

When working with patterns, it is important to start with elements that differ on only one attribute—such as color, shape, or size—so that children have an easier time recognizing the pattern. It is also critical to provide a long enough sequence for children to figure out how the elements repeat, grow, or decrease.

### Working with Repeating Patterns

#### Children need to be able to:

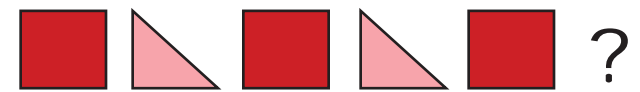
- ◆ Determine the ways the elements are the same or different
- ◆ Recognize when the group of elements begins repeating
- ◆ Note the number of elements in the repeating group
- ◆ Use observations to make predictions about what comes next

- Greenes, 1999

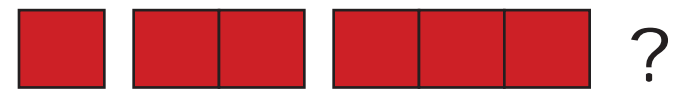
Simple Repeating Color Patterns



Complex Repeating Color AND Shape Pattern



Simple Growing Pattern



Complex Growing Shape, Quantity, AND Color Pattern





## Adult Support for Preschool Development of Pattern Concepts



### Materials, Environments, Experiences, and Language

One important way that adults can support learning about patterns is to help children notice and talk about patterns. These can be patterns in the environment, daily routines, books, or games. Adults should also provide a variety of planned experiences with patterns throughout the curriculum.

#### For example, adults can:

- ◆ Provide opportunities for children to sort or arrange items like lids, buttons, and toy animals by an attribute, such as the color of lids, number of holes in buttons, or where animals live
- ◆ Create patterns with children and encourage them to make and describe their own patterns
- ◆ Plan for patterning not only with physical objects, but choose songs, stories, and games that involve patterns
- ◆ Talk about the regular, predictable parts of the school day—such as breakfast, greeting time, outdoor time—and ask children what comes next in the day
- ◆ Represent movement, object, or sound patterns with pictures or symbols, such as using felt fruit pieces or plastic fruit so children can show the growing pattern in *The Very Hungry Caterpillar*

*"The teacher's role is to provide a bridge between children's informal observations of patterns and the more formal mathematical descriptions of patterns and changes."*

- Copley, 2000, p83



### Materials to Support Patterning

- ◆ Lotto or other matching games
- ◆ Objects to sort and pattern like toy animals, beads, buttons, Unifix cubes, coins, etc.
- ◆ Blocks, geoblocks
- ◆ Musical instruments to explore rhythm and tempo
- ◆ Art supplies like paper strips, dot stickers, and paint doobers
- ◆ Large, posted daily schedule

## Adult Support for Preschool Development of Pattern Concepts



***Look for and listen to Pattern experiences  
and interactions in Head Start Programs***

Preschool Center-Based Classrooms and Family Child Care Homes	Home-Based Option Family Settings
<p>"Picturing America" posters are displayed in the classroom at children's eye level. Bobby traces his finger over the bold patterns and designs on the Anasazi baskets and vases.</p>	<p>During Math Family Night, preschool children make woven place mats out of paper strips with a family member's help. The home visitor walks among them, talking about the repeating color patterns she sees and encouraging parents to do the same.</p>
<p>During group time, Teacher passes out Unifix cubes to everyone. She makes and describes a simple color pattern and encourages the children to copy it. Tina and Bobby immediately do so, but TJ stacks his cubes to make a tower.</p>	<p>When the home visitor arrives, she finds Terry on the floor using bottle caps to create patterns. The home visitor sits down and asks Terry about what he's making.</p>
<p>In the family child care home, musical instruments are always available on a low shelf. Tameka and Joy find the tambourines and shake them. Tameka tells Joy, "Shake it like this." <i>Shake, shake! Shake, shake!</i></p>	<p>Mimi's mother tells the story <i>The Very Hungry Caterpillar</i> by Eric Carle. Mimi puts fruit shaped felt pieces on a simple felt board they made the week before. The home visitor makes comments about the pattern in the story like, "He's eating one more each day!"</p>
<p>Teacher and the children sit in a group to briefly discuss the daily schedule. TJ comments that today's schedule is like yesterday's—everyday they have group, and then everyday after group they play.</p>	<p>At the family's home, Joy and Harry love to hide under the quilt hanging on the sofa. When the home visitor sees them there, she "finds" them and then coaxes them out by saying, "This quilt is full of patterns. What's your favorite piece?"</p>



## Language is Key—Birth to Five

Here are two Pattern scenarios featuring the *Follow the CAR* dialogic strategies. The strategies require adults to follow the child's lead and give the child time to talk. This encourages longer, richer conversations about children's interests and is a perfect opportunity to mathematize children's experiences.

### INFANT/TODDLER SCENARIO

In the Older Infant Room, Teacher Mary sits on soft quilts with Jacob while the other children nap.

(FOLLOW) Jacob crawls and reaches up to Teacher Mary. "Do you want me to pick you up?" she asks. He stretches toward her and she picks him up in her lap.

(COMMENT) "Oh, you're getting so big!" Teacher Mary says with a smile. He cuddles for a minute, and looks at the quilt.

(FOLLOW) The quilts are new and the children have been particularly interested in the colorful quilted hearts with buttons. Jacob reaches toward a quilted heart.

(COMMENT) "You like to touch the hearts," says Teacher Mary. She helps him down and he scoots over and reaches for a button.

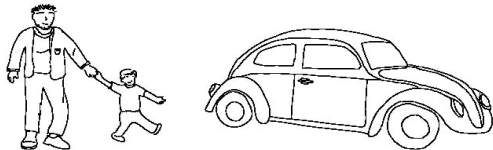
(ASK) "Do you feel the buttons?" asks Teacher Mary. She pauses and looks at Jacob's face. Jacob looks back at her and babbles. "Yes, hard buttons," she says.

(FOLLOW and COMMENT) He touches the soft part of the quilt and then looks at Teacher Mary again. "That part is soft, isn't it?" she comments.

(RESPOND) He touches the button again, clicking it with his fingernail. He looks at Teacher Mary and says, "Eh?" She replies saying, "Yes, a button. It's hard, not soft."

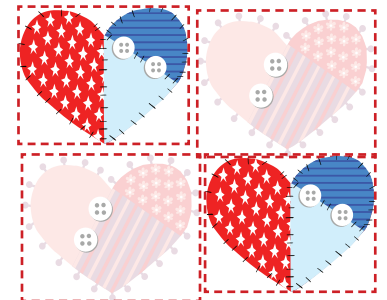


### Follow the CAR



#### Follow the child's lead and then:

- ⇒ Comment and wait, or
- ⇒ Ask question and wait, or
- ⇒ Respond by adding a little more and wait, or
- ⇒ When speaking in the home language and a child says a word in English, repeat the word in the home language





## PRESCHOOL SCENARIO

The preschool children are playing outside. Teachers Gaby and Marty notice that some are wandering a little aimlessly, so Marty decides to initiate a group game.

(COMMENT) Gaby says, "Teacher Marty is going to play a pattern game over by the wall. If you are interested, please join him over there."

(ASK) As children gather, Marty asks, "Who would like to do the 'Hokey Pokey?'" The children shout, "Me, me!" Marty starts singing, "You put your right foot in, you put your right foot out..." demonstrating the movements. The children follow along with the words and the rhythm.

(FOLLOW) Marty notices a child having trouble keeping up. So he slows the tempo down a little bit.

(ASK) "Want to do it again?" asks Marty. "Yeah!!" This time, Marty does the actions and asks the *children* to remember and sing the words. So when Marty puts his right hand in, the children sing and shout "Right hand in!" and so on.

(FOLLOW) When the song comes to the end the children want to continue, so Marty asks, "Who wants to add a *new* body part to the song?"

(RESPOND) "Belly button!" shouts a little girl. Marty starts the song again, extending the song with the girl's suggestion, "You put your belly button in. You put your belly button out..."

(FOLLOW) Back inside, the children who learned the "Hokey Pokey" start to sing and show the rest of the children. The teachers follow their interest and enthusiasm and begin circle time with a show-and-tell of the "Hokey Pokey" song and dance.

The "Hokey Pokey" lyrics and music are available at <http://kids.niehs.nih.gov/lyrics/hokey.htm>.



## Follow the CAR

Follow the child's lead and then:



- ⇒ Comment and wait, or
- ⇒ Ask question and wait, or
- ⇒ Respond by adding a little more and wait, or
- ⇒ When speaking in the home language and a child says a word in English, repeat the word in the home language

*Language Is the Key—Follow the CAR* is a multimedia resource distributed by the National Head Start Family Literacy Center. If your program does not have the book and DVD already, email [info@wlearning.com](mailto:info@wlearning.com).





# Ongoing Monitoring, Supervision, and Professional Development



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## Introduction

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This section is designed to help ensure Head Start and Early Head Start programs provide high quality experiences and individualized instruction related to Patterns. The first step in this process is to gather program information through observation, self-assessment, ongoing monitoring, and child-outcomes data. Next, educational leaders need to analyze the information collected to form conclusions about program-wide as well as individual-teaching staffs' needs. Finally, decisions must be made about the professional development or supervisory approaches best suited to the needs, culture, strengths, and learning styles of your staff.

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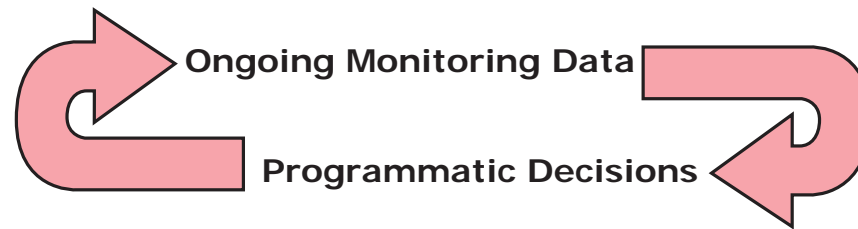
### The following pages contain resources about:

- ◆ Data collection through ongoing monitoring, classroom observation, and program self-assessment
- ◆ Mentoring and reflective supervision to support reflective practice and professional development
- ◆ Ongoing support of infant, toddler, and preschool children's development in the area of Patterns
- ◆ Professional development tools to support staff in center-based, family child care, and home-based program options



## Using Data from Monitoring Systems to Make Decisions

Head Start and Early Head Start programs are faced with the ongoing task of making decisions—both small and large—to ensure positive outcomes for children. Answers to challenges may surface quickly and be easily put into practice. Other times a more thorough approach is needed to define a problem, decide upon a solution, and plan for implementation.



The High Five Mathematize Guide is meant to help Head Start and Early Head Start leaders to 1) become more familiar with child development in the areas of mathematics, 2) find out what are the math strengths and needs of children and program staff, and 3) provide some professional development tools to meet those needs, and capitalize on existing strengths.

The following page provides four categories and questions to help organize an approach to decision-making about math teaching and learning. The categories are:

- ◆ Staff Behaviors and Teaching Practices
- ◆ Learning Environments and Materials
- ◆ Child Behaviors
- ◆ The School-Home Connection

In addition, there are dozens of Program Planning resources on the Early Childhood Learning and Knowledge Center (ECLKC) website at <http://eclkc.ohs.acf.hhs.gov>, as well as observation tools such as those listed to the right.

### Tools to Guide Observation and Monitoring

1. SOLAR Infant/Toddler Classroom Staff Skill Profile (See Appendix)
2. OHS Math Environmental Scan (See Appendix)
3. OHS Math Patterns Webcast #5
4. OHS Monitoring Protocol: Education and Early Childhood Development



## Using Data from Ongoing Monitoring to Make Decisions

Ongoing monitoring, classroom and staff observations, and even informal classroom visits, provide opportunities to look for behaviors and environmental factors that support positive outcomes for children.

### Staff Behaviors and Teaching Practices

- ◆ Are staff creating learning experiences and environments that expose children to a variety of patterns?
- ◆ Are planned *and* spontaneous conversations taking place that are responsive to children's questions and interests related to patterns, sorting, matching, and seriation?
- ◆ Describe how staff use "math talk" or otherwise mathematize children's everyday moments to highlight patterns and pattern-related concepts (like sorting and matching).
- ◆ How do staff involve families in patterning, sorting, and matching experiences?

### Learning Environments and Materials

- ◆ Do the learning environments (indoor and outdoor) have a range of materials available for learning about, exploring, and creating patterns?
- ◆ Does the environment encourage children to match and sort objects according to one or two attributes, put objects in a series, and seriate collections of similar objects?

### Child Behaviors

- ◆ Are children engaged in experiences and talking about making patterns with a variety of materials/sounds/actions, comparing objects and their characteristics, and sorting and grouping objects around them?
- ◆ How does the ongoing observation and child assessment information inform teachers' planning?



This teacher talks with a young girl about a repeating color pattern.

### The Home-School Connection

- ◆ Is information shared with families about how to support patterning skills and concepts at home?
- ◆ Is math a part of family-education or parent meetings?
- ◆ Are families encouraged to think of themselves as mathematicians in the course of their daily lives, and empowered to help their children?



# Using Data from Ongoing Monitoring to Make Decisions

The Office of Head Start created a versatile tool, the Environmental Math Scan\*, to help improve the math learning environment, teaching behaviors and children’s math classroom experiences. The Math Scan may become a regular part of a program’s system of ongoing monitoring. Managers or supervisors can do a Math Scan in each classroom or ask teachers to pair up and complete a peer-scan of each others’ rooms.

The Math Scan is broken up into sections. Part I (below left) focuses on the classroom arrangement, materials, and equipment. Part II requires observations in the learning environment, looking at spontaneous and planned teaching behaviors. As a general rule “a little goes a long way”. Completing one math scan per year and the subsequent analysis of the data (see analysis tool below right) can yield useful data and lead to thoughtful decisions about future training and professional development.

**Math Scan Part I: Inventory of Materials & Equipment**

**Directions:**

Part I is designed to help you determine the potential of materials and equipment available in the learning environment to address the mathematical learning of young children. Materials and equipment that can support early math concepts may be located in a variety of areas. Such equipment and materials offer the potential for teaching teams to “mathematize” children’s learning experiences.

Check the box labeled *Observed* if you can answer “YES” to the question. If you did not see sufficient evidence to let you answer the question, then mark the box labeled *Not Observed*. You may document details of your observations of the set-up of the learning environment (or outside playground areas), specific materials, daily schedule, labeled areas of the environment, etc. that you determine to be math-related in the *NOTES*.

\*\*\*\*\*  
Please provide the information below when you begin your observation:

Number of children present: \_\_\_\_\_  
 Number of adults present: \_\_\_\_\_  
 Beginning time of observation: \_\_\_\_\_  
 Ending time of observation: \_\_\_\_\_  
 Activities taking place (such as circle time, free play, lunch time): \_\_\_\_\_

How many times have you observed previously in this classroom using the math scan? \_\_\_\_\_

**Room Arrangement, Materials, Equipment**

1. Do you see math materials available for children’s use? (Examples: measuring tools, scales, number lines, counting bears, unit blocks, pattern blocks, cash register, computers with children’s software)  
 Observed  
 Not observed  
 NOTES:

2. Do you see teacher-made, class-made, or commercially produced math-focused displays in the classroom environment? (Examples: a border of numerals around the perimeter, bulletin board displays, graphs, charts, or measurement of children’s height)  
 Observed  
 Not observed  
 NOTES:

1



**OHS Environmental Math Scan Data Analysis Tool** **Date:** \_\_\_\_\_

<b>Mathematics Domain Element (check one)</b>	Are there appropriate <b>planned</b> experiences and conversations to support this math Domain Element?	Are there appropriate <b>spontaneous</b> experiences and conversations to support this math Domain Element?	Do lesson plans, materials, and room arrangement show evidence of thoughtful experiences and individualization related to this Domain Element?	Review the math outcomes data reports. Are the preschool child outcomes positive? Where are the strengths and weaknesses?	Next Steps: Professional Development Planning
<input type="checkbox"/> Pattern <input type="checkbox"/> Geo/SS <input type="checkbox"/> Numb/Ops <input type="checkbox"/> Measurement					What kind of support, materials, resources, or training will best meet the individual and collective needs of the teaching staff?
Site: _____ Classroom: _____					
Teachers: _____					
Site: _____ Classroom: _____					
Teachers: _____					

Use this tool to summarize data from the OHS Math Scans conducted in each classroom. Copy as many as needed. Look at all the data together to write a response to the Next Steps questions in the last column.

\*See Appendix for Math Scan and Analysis Tool.

## Mentor Coaching and Reflective Supervision

Mentor-coaching and reflective supervision help teaching and home visiting staff improve their professional practice. The mentor-coaching skills in the boxed-list are general and not specific to Pattern, or any other area. They are general skills for supervisors and mentors to consider and employ. Read how these skills can support staff and, ultimately, result in positive Pattern outcomes for children.

*One mentor coach remembers the Steps to Success Professional Development Plan\* as a useful tool when she went through the curriculum. She wants to create and use a similar tool that focuses on math for the teachers she mentors.*

The training coordinator is planning a math in-service focusing on Patterns. After watching the OHS Math Webcast #5 she sees how music and movement are used to promote patterns development. At the in-service, she invites small groups to perform and highlight the patterns in favorite songs and dances from their own childhood.

*A Director realizes his managers needs help with reflective supervision and conferencing. Being familiar with Steps to Success, he pulls videos from the DVDs that discuss and model reflective conferences. (Steps to Success DVD Unit 2: Chapter 3 and DVD Unit 3: Chapters 3, 4, and 5).*

A pair of new teachers ask their supervisor for help supporting their high-needs children. The supervisor meets with the teacher, and shares and discusses the STEP-Doc 4.3a: Individualized Instruction Strategies to Support Each Child\* from Steps to Success Unit 4.

### Mentor-Coaching Skills\*

- ◆ Professional Development Planning
- ◆ Setting Achievable Goals
- ◆ Problem Solving
  
- ◆ Relationship Building
- ◆ Sharing Values
- ◆ Culturally Sensitive Approaches
- ◆ Self-Reflection
- ◆ Communication, Listening, and Reflective Inquiry
  
- ◆ Observation and Use of Observation Tools
- ◆ Reflective Conferencing
- ◆ Journaling
- ◆ Providing and Receiving Feedback
  
- ◆ Child Assessment
- ◆ Individualizing Instruction

\*STEP-DOC 4.3a and Professional Development Plan are at the end of chapter.

## Self-Assessment for Early Head Start Staff

This self-assessment\* can be completed by Education Managers, supervisors, and/or teaching staff. The information can then be used, in a non-evaluative way, to make decisions about topics for program-wide training or used on an individual level with staff to provide tailored mentor-coaching or reflective supervision. Insight from the self-assessment may also help staff identify their own professional development goals. Page ahead to find additional self-assessments to use with Head Start staff and home-based staff.

*\*See the end of the chapter for full-size versions of the Patterns Self-Assessments.*

Skills for Adults Working with Children Birth-3 Years of Age	Patterns				
	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
I know how our program's infant and toddler curriculum and assessment tools address sorting, matching, and patterning.	1	2	3	4	5
I understand what to expect infants and toddlers to know and be able to do related to patterns.	1	2	3	4	5
I develop and write teaching plans to engage babies and toddlers in multi-sensory experiences that support their matching, sorting, and grouping abilities.	1	2	3	4	5
I recognize that routines are patterns in themselves and that routines help create a safe, secure environment for young children.	1	2	3	4	5
I know about and use resources to support children's developing knowledge and skills related to classifying, grouping, and patterning objects.	1	2	3	4	5
I mathematize or find the patterns in infants' and toddlers' daily routines and interactions.	1	2	3	4	5
I provide families with information, experiences, and vocabulary to use at home related to patterns, matching, and sorting.	1	2	3	4	5

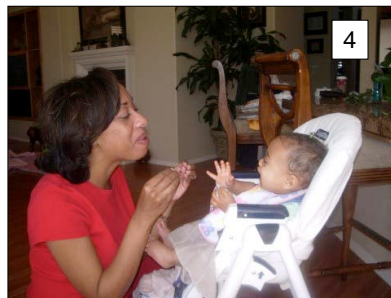
## Professional Development

**Where are the patterns?** Discuss pattern-related concepts and vocabulary embedded in these everyday moments and interactions.



**Mathematize** means to bring out, or highlight, the math concepts during an interaction with a child or group of children. Adults can mathematize a child's experience by:

- using math language
- emphasizing math concepts
- posing math questions or problems to solve
- providing engaging materials and opportunities that support mathematical thinking



## Ideas for Staff Working with Infants and Toddlers

**Mathematize** means to bring out, or highlight, math concepts during an interaction with a child or group of children.

Adults mathematize in a variety of ways, but the first step in mathematizing is to recognize math concepts embedded in what children are exploring or experiencing.

Everyday routines and interactions are a great place to look for math concepts. The photo-collection, pictured left, captures commonplace moments and interactions in the lives of infants and toddlers.

Use the pictures on the *Where are the patterns?* handout\*, or a collection from your own program, to discuss the role and importance of patterns in infants' and toddlers' lives. Pictures featuring feeding, napping, bedtime, getting dressed, book reading, diaper changing, or other routines will facilitate the discussion.

Discussion Questions:

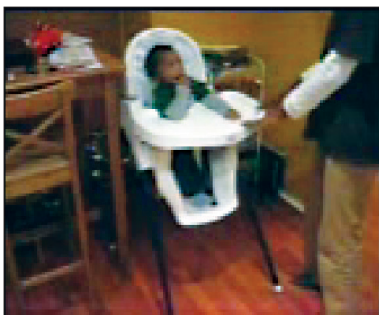
- ♦ What pattern-related concepts are embedded in these everyday activities?
- ♦ What "math talk" could adults use to highlight the patterns embedded in these interactions?
- ♦ What other routines in children's lives are pattern-based?
- ♦ Why are patterns, like *routines*, critical in infants' and toddlers' lives?

\*A full-size handout is available at the end of this chapter.

## Professional Development

### Ideas for Staff Working with Infants and Toddlers

Another effective training approach is to have staff analyze and discuss video clips of children in action. The "Playful Patterns" infant video clip is available on the OHS Math Webcast #5 on the ECLKC website. The "Cultural Song and Dance" video is located in the Patterns folder on your High 5 Mathematize DVD. Videos can be used for small or large group trainings, or during family meetings.



#### "Playful Patterns"

Playful Patterns is a clip from the OHS Patterns Webcast #5. Before watching this video, brainstorm different types of patterns that infants and toddlers encounter in their lives (repeating patterns in language, routines, songs, games, etc.). Have EHS staff watch this clip of an infant in a high chair interacting with an adult. You may want to watch the video more than once.

The following questions can be used to facilitate the discussion.

- ♦ What did you notice?
- ♦ What kinds of patterns did you observe in this video?
- ♦ What pattern-related skills might this child be learning?
- ♦ How would you describe the quality of this adult-child interaction?

#### "Cultural Song and Dance"

Before watching the short song and dance performed by Alaska's RuralCAP Head Start staff, have the audience brainstorm and discuss patterns embedded in children's music and movement songs (e.g., growing patterns, repeating rhymes, rhythms and beat, language, and movements). Then watch the clip.

Use or modify the following discussion questions.

- ♦ What did you notice?
- ♦ How would you describe the patterns in this song/dance?
- ♦ How can songs and dances that are culturally significant also support children's knowledge of patterns?





**Books with Patterns** in the National Head Start Family Literacy Center Finding the Math in Books Resource:

- ◆ **We're Going on a Bear Hunt** by Michael Rosen
- ◆ **Polar Bear, Polar Bear, What Do You Hear?** by Bill Martin, Jr.
- ◆ **Goodnight Moon** by Margaret Wise Brown
- ◆ **Goodnight Gorilla** by Peggy Rathmann
- ◆ **More, More, More Said the Baby** by Vera B. Williams
- ◆ **The Carrot Seed** by Ruth Krauss and Crockett Johnson
- ◆ **The Very Hungry Caterpillar** by Eric Carle

### Ideas for Teaching Staff and Home Visitors Working with Infants and Toddlers

Patterns are all around us. Adults can help children notice patterns in the world. Books are *great* places to find patterns. Some books highlight visual patterns in the illustrations. Others incorporate patterns in the rhyme and rhythm of the words themselves or in the plot line of the story.

Gather a collection of favorite infant/toddler books for the next Early Head Start staff meeting (suggestions at left). Give each small group a different book or collection of books to read and analyze. Focus the analysis on identification and description of patterns in each book. Use or modify the following discussion questions:

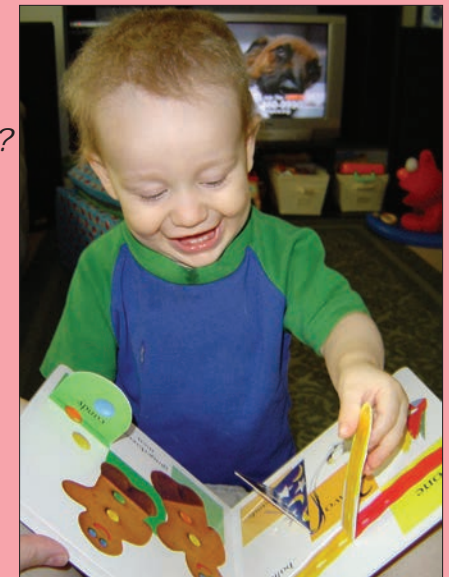
- ◆ *Are there repeating and/or growing patterns?*
- ◆ *What are the visual patterns?*
- ◆ *Describe the language/oral patterns.*
- ◆ *How could you highlight these patterns with children and families?*

#### Infants and toddlers can learn from books with patterns.

- ◆ Exposure to patterns helps very young children learn language
- ◆ The structure of patterns helps young children learn and remember
- ◆ The regularity of patterns allows young children to predict what is coming next and to participate directly in book reading

#### Parents and teachers can use pattern books with infants and toddlers.

- ◆ Point to the elements of visual patterns as you label them
- ◆ Help children notice auditory patterns by choosing books with repeating refrains and emphasizing the repeating words and phrases



\* Finding the Math in Books is available in the Appendix.

## Self-Assessment for Head Start Staff

This self-assessment\* can be completed by Education Managers, supervisors, and/or teaching staff. This non-evaluative assessment information can assist in decision-making about professional development for all staff meetings, site-based trainings, in-service and pre-service, or individual staff.

*\*See the end of the chapter for full-size versions of the Patterns Self-Assessments.*

Skills for Adults Working with Children 3-5 years of age	Patterns				
	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
I know key indicators related to Patterns.	1	2	3	4	5
I understand what to expect children ages 3-5 to be able to do related to patterning, sorting, and organizing objects according to one or two attributes.	1	2	3	4	5
I use and write teaching plans that engage preschoolers in developmentally appropriate pattern experiences.	1	2	3	4	5
I mathematize or find the patterns in preschooler's daily routines and interactions.	1	2	3	4	5
I recognize and support emerging skills as children sort by, compare, and describe attributes (e.g., shape or color).	1	2	3	4	5
I use, and encourage children to use, language to describe patterns (e.g., repeating or growing) and attributes.	1	2	3	4	5
I provide families with information and experiences related to matching, sorting, and patterning to do at home.	1	2	3	4	5
I know where to find resources about children's developing knowledge and skills related to patterns.	1	2	3	4	5

### Ideas for Staff Working with Preschoolers

**Mathematize** means to bring out, or highlight, math concepts during an interaction with a child or group of children. In order to mathematize often and effectively, Head Start staff need opportunities to talk and think about patterns and the underlying skills and abilities that support patterning, like sorting and matching. These professional opportunities prepare staff to mathematize and use math talk when they are with children and families.

Here is one approach to increase staff knowledge and encourage discussion about patterns and related skills. Provide a variety of materials during an in-service or training day. Have staff classify, sort, match, organize, group and regroup, and create patterns. Staff should be asked to identify attributes, or characteristics, of materials at their table (color, size, quantity, material, shape, texture, etc.) used to make patterns. Read the captions for examples of teacher-created patterns or pattern-related skills.



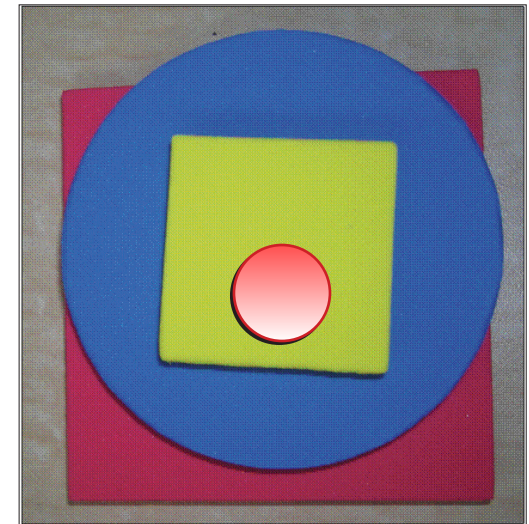
This is an example of sorting by attributes. The four chickens have been separated from all other types of animals.



This "plus one" growing pattern is made with recycled lids.



This is a color pattern using Unifix cubes. Brown and orange cubes make a simple repeating (ABAB) pattern.



This pattern is based on two attributes—shape and position—of the objects. A square, circle, square, circle pattern repeats in an UPWARD direction.

## Professional Development

### Ideas for Staff Working with Preschoolers

A Jigsaw activity is a professional development strategy. A whole book, chapter, or article is divided into smaller “jigsaw” pieces and assigned to or chosen by small groups. The small groups then read, discuss, and prepare to report on their piece to all the other small groups.

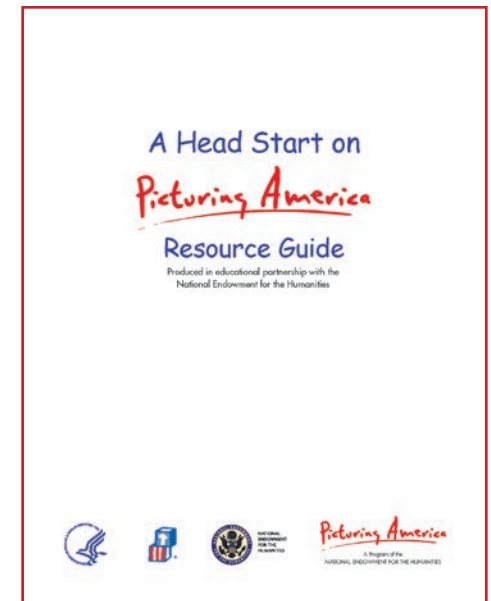
Try using sections from *A Head Start on Picturing America Resource Guide* for a Jigsaw activity focused on Patterns. *1-A Pottery and Baskets\** and *10-B Quilts\** both lend themselves very nicely to conversations and lesson-plans about attributes, like shape and color, and patterns. Prior to asking Head Start staff to participate in a Jigsaw, the facilitator should read and reflect on the jigsaw pieces. Forming a set of Jigsaw Discussion Questions is also important. Try using or modifying the following questions:

- ♦ What did you learn?
- ♦ What are the key ideas in the section you read?
- ♦ How did your section relate to the area of Patterns?
- ♦ What ideas, information, and/or extension activities related to Pottery, Baskets, or Quilts could you use with children or families?



#### Top Ten Tips for Success with *A Head Start on Picturing America*

1. Follow the children’s lead.
2. Find the fit with your curriculum.
3. Select artworks that reflect your children, families, and community.
4. Create ways to extend learning and conversations.
5. Connect with curriculum outcomes.
6. Sow seeds of creativity—yours and theirs.
7. Encourage connections between the present and past.
8. Consider sequence and time—pacing.
9. Involve families and parents.
10. ENJOY!



\*Sections 1-A and 10-B are available at the end of this chapter.



## Professional Development

### Ideas for Staff Working with Preschoolers

The OHS Math Webcasts were developed with managers, coordinators, and other educational leaders as the primary audience.

- ♦ Make time to watch and analyze the full-length OHS Math Webcast #5 on Patterns
- ♦ Gather your education leadership team together (site supervisors, coordinators, mentors, master teachers, directors) and use the Viewer's Guide\* (pictured right) to guide your viewing and discussion of Webcast #5
- ♦ When you are done, decide how to use or share the information with teachers and other staff in the program



Along with the full-length OHS Patterns Webcast #5, the following Pattern video lessons are on the ECLKC Website:

- ♦ *Mrs. McTats and Her House Full of Cats*
- ♦ Number Patterns
- ♦ Growing Patterns
- ♦ Repeating Patterns
- ♦ Pattern Songs



### Math Webcast #5: Patterns Viewer's Guide for Math Leaders

#### Key Points

Patterns can be established or recognized whenever outcomes are regular and predictable.

Patterns are a part of children's everyday experiences.

Pattern can be understood as an integrated part of numerous mathematical and non-mathematical curriculum domains.

#### Part I: What do children need to know to understand patterns?

Give examples of identifiable, culturally significant patterns available children in your program.

What is the definition of a pattern?

Give an example of a repeating pattern. Give an example of a growing pattern. Explain why your examples are regular and predictable.

Explain how to improve a child's sense of predictability as it relates to patterns in various environments (i.e. the child's home, classroom, supermarket, etc.)

Why is it important for patterns to be a part of a young child's experiences?

Give an example of patterns that enhance children's learning experiences.

Give an example of how understanding patterns benefits the long-term education outcomes of children.

Pick two or more domains or domain elements from the Child Outcomes Framework and give examples of related lessons or experiences that would enhance a child's understanding of pattern.

Explain the process of:

identification  
replication  
completion

\*The viewers guide is located at the end of this chapter.



## Self-Assessment for Home-Based Staff

This self-assessment\* can be completed by Education Managers, supervisors, and/or teaching staff.

This non-evaluative assessment information can assist in decision-making about professional development for all staff meetings, site-based trainings, or individual staff.

*\*See the end of the chapter for full-size versions of the Patterns Self-Assessments.*

Skills for Adults Working with Parents and Children in Home-Based Program Option	Patterns				
	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
<b>For Early Head Start:</b> I understand birth-to-three development related to patterns.	1	2	3	4	5
<b>For Head Start:</b> I know key Pattern indicators.	1	2	3	4	5
I help families feel confident in their ability to talk about patterns (e.g., growing and repeating) and attributes (e.g., size, shape, color) with their children.	1	2	3	4	5
I model how to find the patterns in families' daily routines, interactions, and environments.	1	2	3	4	5
I write and use teaching plans that engage children and families in multi-sensory, pattern experiences.	1	2	3	4	5
I provide families with information and age-appropriate pattern activities to do with their children.	1	2	3	4	5
I point out and discuss patterns and materials families have in their home (e.g., kitchen containers, dishes, tile, textiles, etc.) to support patterning.	1	2	3	4	5

## Professional Development

### Ideas for Staff Working in Home-Based Program Option

Head Start and Early Head Start staff who conduct home-visits are in the unique position to support both children and their families simultaneously. Have home visiting staff analyze and discuss if and how they might use the following worksheet\* during a home visit to encourage positive child outcomes in Patterns.

### Helping Parents Find the Patterns in Children's Lives

Children's lives are full of patterns in routines and scheduled events. The predictability of their everyday routines and care are essential to their sense of security.

Home visiting staff can help parents articulate their daily schedules and routines using the worksheet (at right). After talking through and writing down the daily schedule, the home visitor and parent can discuss the patterns that are *embedded* within routines (e.g., breakfast, naptime, bath time, reading rituals).

A repeating pattern that occurs before naptime, for example, might go something like this:

- ◆ Clean up toys
- ◆ Change diaper
- ◆ Find "blanky" or favorite stuffed animal
- ◆ Rock in the rocking chair
- ◆ Sing a lullaby
- ◆ Tuck into bed and say, "Good night, sleep tight."

**Patterns in Routines and Everyday Situations**  
Write your daily schedule or routine. Then, list as many connections to patterns as you can.

Remember that patterns are anything—events, objects, sounds, words, actions—that occur in a predictable sequence. So, anything that is a routine is essentially a repeating pattern. You use the same or similar sequence or words and actions every bedtime, naptime or reading time, for example. Also, don't forget to look for patterns in the world around you and in the language learning and songs of early childhood.

Time	Routine, Activity	Connections to Patterns

\*This handout is available at the end of this chapter.

## Professional Development

### Ideas for Staff Working in Home-Based Program Option

During a home visit, staff can encourage positive child outcomes related to Patterns. Encourage home visiting staff to read through the research below about the importance of talking with children about attributes. Staff could use the list of household objects to brainstorm language and vocabulary—math talk—that describe the attributes of items found in the home environment.

### Sorting, Matching, Seriation, Organizing, and Grouping Household Objects

When children sort, match, and group objects they are learning about the attributes of those objects. Attributes, or characteristics, of objects include size, shape, quantity, material, texture, orientation, etc.

There are any number of household items that children can sort, match, organize, group, and regroup. Hands-on experiences with household items, such as the following, combined with adults using math talk, can support children's math development:

- ◆ Measuring cups (or other nesting containers)
- ◆ Laundry (e.g., sorting clothes by color, matching socks or mittens)
- ◆ Muffin tins and small objects like coins or buttons
- ◆ Materials that can be organized:
  - ◆ shoes and socks
  - ◆ lids
  - ◆ plastic or paper plates, bowls, cups, and utensils
  - ◆ large nuts and bolts
  - ◆ coins
  - ◆ natural objects like leaves, rocks, flowers, and seeds
  - ◆ playing cards
  - ◆ beads, buttons, and other craft items

*A number of studies have demonstrated the importance of adults talking with children about objects and their characteristics. These experiences:*

- ◆ *Enhance children's growth in vocabulary and build background knowledge (Bridges, 1979; Smith, Landry, & Swank, 2005)*
- ◆ *Impact greatly when offered during play-oriented, problem-solving activities (puzzles, stacking blocks, etc.)*
- ◆ *Are a critically important feature of book reading activities (Landry & Smith, 2006)*

## Notes



**STEP-Doc 4.3 b:  
A Framework for Embedding Individualized Instruction**

- 1. Think about the routines and experiences of the day, whether in a classroom, family child care program, or at home.**
  - Look at the class schedule, daily routines, and plans.
- 2. Identify child outcomes that can be paired with routines.**
  - What do you expect children to typically know and be able to do at these times?
  - Which routines and activities provide the best opportunities for children to practice and acquire language and literacy skills?
- 3. Think about how outcomes are intentionally taught or experienced during the routines of the day.**
  - What does the child do during routines?
  - What is his or her level of current skill for the skill or outcome assessed?
  - How does he or she participate?
- 4. Develop strategies for individualizing instruction.**
  - List the outcomes or skills the child needs to acquire in order to more actively or fully participate in the class routines and experiences.
  - Choose routines during which specific outcomes will be emphasized. Limit the number of routines to no more than three.
  - Describe the teacher instruction and interaction that will be used to support this child's acquisition of these skills or outcomes.



**Measurement**

How will I keep track of my progress or success on this goal?	
What is my timeframe for working on this measurement goal?	
What kind of support do I need to meet my goal (materials, resources, peer input, etc.)?	
What goals do I have for helping children and families in the area of measurement (e.g. activities, experiences, math talk)?	

## Mentor-Coaching and Reflective Supervision Skills

- ◆ Professional Development Planning
- ◆ Setting Achievable Goals
- ◆ Problem Solving
  
- ◆ Relationship Building
- ◆ Sharing Values
- ◆ Culturally Sensitive Approaches
- ◆ Self-Reflection
- ◆ Communication, Listening and Reflective Inquiry
  
- ◆ Observation and Use of Observation Tools
- ◆ Reflective Conferencing
- ◆ Journaling
- ◆ Providing and Receiving Feedback
  
- ◆ Child Assessment
- ◆ Individualizing Instruction

For more information and training materials on professional development, mentoring, reflective supervision, and early childhood mathematics, visit the Early Childhood Learning and Knowledge Center (ECLKC) at <http://eclkc.ohs.acf.hhs.gov/hslc>.



## Professional Development Plan



The High Five Mathematize Professional Development Plan supports early childhood professionals. The Plan focuses on acquiring, improving, and refining teaching and home visiting practices to support mathematics for children from birth to five.



National Head Start Family Literacy Center

*High Five Mathematize*

## Number and Operations

What goals do I have for helping children and families in the area of number and operations (e.g. activities, new experiences, math talk)?	What kind of support do I need to meet my goal (materials, resources, peer input, etc.)?	What is my timeframe for working on this number and operation goal?	How will I keep track of my progress or success on this goal?

## Geometry and Spatial Sense

What goals do I have for helping children and families in the area of geometry and spatial sense (e.g. activities, new experiences, math talk)?	What kind of support do I need to meet my goal (materials, resources, peer input, etc.)?	What is my timeframe for working on this geometry and/or spatial sense goal?	How will I keep track of my progress or success on this goal?

## Patterns

What goals do I have for helping children and families in the area of patterns (e.g. activities, new experiences, math talk)?	What kind of support do I need to meet my goal (materials, resources, peer input, etc.)?	What is my timeframe for working on this pattern goal?	How will I keep track of my progress or success on this goal?

## 1-A Pottery and Baskets: c. 1100–c. 1960

### Various Artists



1-A.1 Anasazi pottery, c. 1100, Pueblo Bonito, Chaco Canyon. Jar at left, height 10¼ in. (26 cm.). Photograph by P. Holmbeak. © American Museum of Natural History, New York.

### The Art

This poster includes examples of pottery and baskets made in America over the past 900 years. Several of these are highlighted in the following section; however, you may want to spend additional time discussing others that are pictured in the poster.

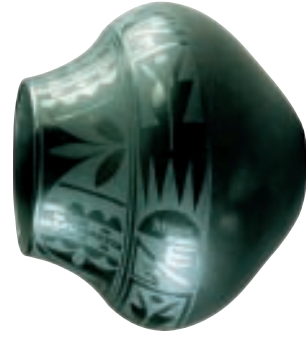
The large piece of black pottery is the most modern of the pots (1-A.3). It is a reinterpretation of ancient pottery finds that were discovered near Santa Fe, New Mexico, in the early 1900s. It took the artists more than eight years to determine how to make the black-on-black works of art. The geometric designs on the pot cover only half of the pottery.



1-A.2 Sikyáiki polychrome bowl, c. 1350–1700, height 3 1/3 in., diameter 10 ¾ in. (9.3 x 27.4 cm.). Catalog no. 155479, Department of Anthropology, Smithsonian Institution, Washington, D.C. Photograph by D. E. Hurlbert.

The baleen basket (1-A.5) was made in Alaska in 1940, by an Inupiat man named Carl Toolak. The stiff fibrous plates in the mouths of whales—the “teeth” of these whales—are called baleen. At the bottom of the basket is an ivory plate with holes drilled around the edges so that the baleen could be threaded to begin the weaving of the basket. The lid is also made with a piece of ivory to serve as a knob. The knob is a carved ivory seal’s head. Baleen comes in a range of colors from light shades of brown to black. In this piece, the white stitches are made of bird quills that form the design on the basket and lid.

The rice basket tray (1-A.6) was made in 1960, by Caesar Johnson, a member of the Gullah people who live on the coast of South Carolina. Gullah is the name of the culture and their Creole language is similar to the Krio language of Sierra Leone. This basket was made to separate grains of rice from the husk of the plant or chaff. Gullah baskets were made from coiled bulrush and saw palmetto or white oak.



1-A.3 María Montoya Martínez and her husband, Julian Martínez (San Ildefonso Pueblo, American Indian), c. 1887–1980; 1879–1943). Jar, c. 1939, Blackware, height 11 1/8 in., diameter 13 in. (28.26 x 33.02 cm.). National Museum of Women in the Arts, Washington, D.C., Gift of Wallace and Wilhelmina Holladay.

The pottery jars (1-A.1) were made by the Anasazi people almost a thousand years ago. These jars were found in the Chaco Canyon in New Mexico. They each have small holes or loops near the top so they could be hung up by rope or cord. The use of these jars is unknown. The geometric designs were painted and fired or baked to set the design on the pottery.

### The Artists

María Montoya Martínez and her husband, Julian Martínez, a Tewa couple on the San Ildefonso Pueblo, were contacted by an archaeologist to recreate a very old style of pottery that was discovered near Santa Fe, New Mexico. The couple tried for years to produce black pots made from red clay. After eight years of trying, the couple discovered how to make a style of ancient pottery with a black-on-black finish.

## The Artists cont...



1-A.4 Louisa Keyser (Dot So La Lee, Washoe, c. 1850–1925), Beacon lights, 1904–1905. Willow, western redbud, and bracken fern root, height 11 ¼ in., diameter 16 in. (28.58 x 40.64 cm.), T751, Thaw Collection, Fenimore Art Museum, Cooperstown, N.Y. Photograph by Richard Walker.

Caesar Johnson was a Gullah artist from South Carolina who designed the flat basket used as a tray to separate grains of rice from their husks. Gullah people are descended from slaves from West Africa. Gullah is the name of the people, their culture, and their language.

Carl Toolak, from the Inupiat people, was among the first of the baleen basket weavers in Alaska. Because baleen is too stiff to use when starting a basket, Toolak used a starter plate of ivory and stitched the first strip of baleen to the edge of the starter plate through holes drilled around the edges.

The Anasazi people made the cylinder-shaped pottery almost a thousand years ago. They were farmers who built homes and small villages across the Four Corners Region, now the area where the borders of New Mexico, Arizona, Utah, and Colorado come together. The Anasazi are known for their architecture, and the largest of these buildings is called the Pueblo Bonita. These six pots were found with about a hundred others in one of the rooms.



1-A.5 Carl Toolak (c. 1885–c. 1945, Inupiat, Point Barrow, Alaska), baleen basket, 1940. Baleen (whalebone) and ivory, height 3 ½ in., diameter 3 1/3 in. (9.0 x 8.5 cm.), Catalog no. 1.2E1180. Courtesy of the Burke Museum of Natural History and Culture, Seattle, Wash.

## The Historical Perspective

The time period for these pieces of pottery spans more than 800 years. The three pieces of pottery on the poster were made between 1100 and 1939. The baskets were made between 1904 and 1960. A thousand years ago, American Indians used plants, bone, skin, earth, and stone to make pots, baskets, arrowheads, and other objects they needed for everyday life. In addition to being useful, many of these objects were beautiful works of art.



1-A.6 Attributed to Caesar Johnson (1872–1960), Gullah rice farmer basket, c. 1960. Rush, height 2 ½ in., diameter 17 ½ in. (6.35 x 44.45 cm.). Courtesy of the South Carolina State Museum, Columbia, S.C. Photograph by Susan Dugan.



# Conversations and Teaching Activities

Head Start Children ages 3 to 5

Encourage children to look closely at the pots and baskets in this poster. Introduce new vocabulary as you probe their thinking and discuss what they see.

## Describing



- ✔ What do you think of when you look at these baskets and pots? How are they alike?
- ✔ How are they different?
- ✔ If you could touch these objects, how would they feel?
- ✔ What are they made of? (Pottery is made of clay. The baskets are made from whalebone, grasses, plants, and willows.)



## Analyzing and Interpreting

Ask the following questions to stimulate thinking and discussion:

- How would you use any of these objects?
- Are there other things you would like to tell me about what you see?



## Connecting and Extending

### Introducing Vocabulary

ceramic	image	spacing
contrast	kilns	spirals
cylinder	pottery	rough
fragile	smooth	weaving



### Books

**A Birthday Basket for Tia** by Pat Mora (Simon and Schuster Children's Publishing, 1997) Cecelia prepares a gift for her great-aunt's 90th birthday.

**Basket Moon** by Mary Lyn Ray (Little Brown Books for Young Readers, 1999) After being sneered at by townspeople, a boy rediscovers the beauty of his family craft and follows in his father's basketmaking footsteps.

**Circle Unbroken: The Story of a Basket and Its People** by Margot Theis Raven (Square Fish, 2007) A grandmother tells the story of the beautiful sweetgrass baskets made by Gullahs that keep their African heritage alive.

Books continued on page 8





## Connecting and Extending continued...

### Related Family Literacy Experiences

Parents and children can:

- ✓ go on a scavenger hunt in their home looking for different textured objects or objects that hold various-sized items.
- ✓ sing the song "A Tisket, A Tasket" during extended waits or long car or bus trips.



### Books continued...

**The Cherokee: Native Basket Weavers** by Therese DeAngelis (Coughlan Publishing, 2003)

Cherokees of the American Southeast made baskets of river cane. When the Indians were sent to Oklahoma, they adapted new materials to continue traditional basket weaving.

**The Pot that Juan Built** by Nancy Andrews-Goebel (Lee and Low Books, 2002)  
Juan Quezada is a Mexican potter who makes beautiful clay pots the same way potters in the area did hundreds of years ago.



### Related Educational Experiences

- ✓ Have a potter visit the classroom to demonstrate pottery making and decorating. Perhaps the potter can bring a small kiln or photos that show the stages of pottery making.
  - ✓ Make a pot out of clay or play dough. Children can make a ball and dig out the center or coil a "long worm" of clay or play dough.
  - ✓ Weave a basket or mat out of colored paper or other materials.
  - ✓ Draw or paint pots and baskets.
  - ✓ Have parents bring handmade pots and baskets to the classroom. Hopefully, they will represent a variety of cultures.
- The ideas listed are just a few of the many activities that could be used to introduce or extend children's learning. Your knowledge of your children and families supports your ability to ensure positive learning experiences and outcomes for students. As an educator, you probably have ideas for books, songs, finger plays, and activities that you have thought of when introducing or extending children's learning related to the "**A Head Start on Picturing America**" artworks. We encourage you to confer with your colleagues, visit the local library or bookstore, and share your ideas with others.

## 10-B Quilts: 19th through 20th centuries

### Various Artists



10B.1 Hannah Greenlee (c. 1827-before 1896) and Emm Greenlee (died c. 1910). *Crazy Quilt*, begun by Hannah and finished by her daughter, Emm, 1896. Fabric scraps (some homespun), length 90 in., width 71 1/2 in. (228.6 x 181.6 cm.). Historic Carson House, Marion, N.C., Gift of Ruth Greenlee.



10B.2 Susan Noakes McCord (1829–1909); McCordsville, Hancock County, Indiana). *Grandmother's Fan Quilt*, c. 1900. Wool, silk, and cotton, length 80 1/2 in., width 70 1/2 in. (204.47 x 179.07 cm.). From the Collections of The Henry Ford, Dearborn, Mich.

### The Art

These eight colorful quilts in different patterns are each a work of art. The quilts were designed and sewn by different women at different times. The first, called *Crazy Quilt*, uses a pattern known as “Contained Crazy” because the crazy quilt squares are lined up into a grid. The second quilt is also a “Contained Crazy” but has a wheeled pattern instead of rectangular bars like the first one. The three Amish quilts that follow the first two are “Bars Pattern” quilts. The last three quilts pictured are also Amish, in a variety of designs: one is a “Diamond in the Square,” another is a “Bars Pattern,” and the third is a “Lone Star Pattern.” Quilting involves sewing together different pieces of material to make coverings for beds.

### The Artist

Hannah Greenlee, a slave, began her *Crazy Quilt*, which was finished by her daughter, Emm. Hannah was freed after the Civil War and probably continued the work of cooking, cleaning, and sewing that she had done as a house servant. The stacked, colored bands she used in her quilt pattern are similar to a cloth pattern made in Africa called Kente cloth.

Susan Noakes McCord made the second “Contained Crazy” quilt, called *Grandmother's Fan Quilt*. McCord was a farmwife from McCordsville, Indiana. In addition to making more than a dozen quilts, she raised vegetables, chickens, and seven children. She made changes to familiar quilt patterns to create her own individual quilt designs.



10B.3 Bars Pattern Quilt, c. 1920. Top, plain-weave wool; back, grey-and-blue plain-weave cotton. Overall dimensions 72 x 80 in. (182.9 x 203.2 cm.). Gift of “The Great Women of Lancaster.” Collections of the Heritage Center of Lancaster County, Lancaster, Pa.



10B.4 Bar Pattern Quilt, c. 1925. Top, plain-weave wool; back, brown-and-white printed-check-plain-weave cotton. Overall dimensions 77.5 x 77.5 in. (196.9 x 196.9 cm.). Given in memory of Louise Stolztus. Collections of the Heritage Center of Lancaster County, Lancaster, Pa.

## 10-B Quilts: 19th through 20th centuries

Various Artists



10-B.5 Split Bars Pattern Quilt, c. 1935. Top, plain-weave and crepe wool; back, black-and-white twill printed-pattern plain-weave cotton. Overall dimensions 76 x 76 in. (193 x 193 cm.). Collections of the Heritage Center of Lancaster County, Lancaster, Pa.



10-B.7 Bars—Wild Goose Chase Pattern Quilt, c. 1920. Top, plainweave and crepe wool; back, wine-and-white floral-print, plainweave cotton. Overall dimensions 72.5 x 79.5 in. (184 x 201.9 cm.). Gift of Irene N. Walsh. Collections of the Heritage Center of Lancaster County, Lancaster, Pa.



10-B.8 Diamond in the Square—Sunshine and Shadow Variation Pattern Quilt, c. 1935. Top, purple plain- and twillweave wool; back, purple twillweave cotton. Overall dimensions 80 x 80 in. (203.2 x 203.2 cm.). Gift of “The Great Women of Lancaster.” Collections of the Heritage Center of Lancaster County, Lancaster, Pa.

The rest of the quilts are made by Amish quilt makers who lived in and around Lancaster, Pennsylvania. At the center of Amish life are religion, family, and community. Amish people live simply in small communities and believe in nonviolence. They live simple lives in small communities and believe in nonviolence. They also believe in getting by without much of the technology used by the rest of America. Women come together to work on quilts, although earlier Amish quilts were probably made by individual women.

### The Historical Perspective

Quilting is an old craft, which has gone through many changes over time. A quilt usually has a piece of material on the top and the bottom, with a layer of ‘batting’ in the middle, which helps make the quilt warm. The layers are sewn or quilted together. In America, before the Revolution, quilts were usually made by wealthy women, who had the time to work on fancy stitching and the money to buy fancy fabrics. As more women began to quilt, they often would cut up old clothes or blankets to use as fabric, since they could not afford more expensive materials. Fabrics began to change and become more affordable with the invention of the cotton gin and power loom.



10-B.6 Lane Star Pattern Quilt, c. 1920. Top, plainweave wool; back, red, green, and white printed-plaid, plainweave cotton. Overall dimensions 89 x 89 in. (226.1 x 226.1 cm.). Gift of Irene N. Walsh. Collections of the Heritage Center of Lancaster County, Lancaster, Pa.

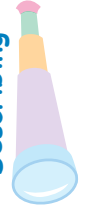


# *Conversations and Teaching Activities*

Head Start Children ages 3 to 5

Encourage children to look closely at the quilts—the patterns and the colors used. Introduce new vocabulary and find books that relate to the artworks.

## **Describing**



- ✓ What is a quilt? How is it different from a painting or a photograph?
- ✓ Have you seen a real quilt? Have you touched a quilt? What was it like?
- ✓ Do any of you have quilts? Maybe someone can bring in a real quilt for the children to see and feel!
- ✓ Do you see differences between the quilts? (Some use big pieces of fabric, others use small pieces of fabric; some use many colors, others use few colors; some use different shapes of fabric like rectangles, squares, and circles.)
- ✓ Can you find shapes (rectangles, triangles, squares) or patterns in the different quilts?
- ✓ Help children find specific shapes and patterns within the quilts. Which quilts have patterns that are alike in some ways but different in others?
- ✓ Have children find similar colors in different quilts.
- ✓ Describe and show how a quilt top, bottom, and filler make a “sandwich.”



## **Analyzing and Interpreting**

Ask the following questions to stimulate thinking and discussion:

- Why do you think the different quilters made their quilts the way they are? (10B1 is probably made of small bits of fabric from many different articles of clothing or things from around the household that had worn out—dresses, pants, jackets, coats, curtains, drapes, blankets, etc. It was made by a woman who had been a slave.)
- Would you like our class to make a quilt? What could we use to make it? Where should we make the quilt?
- Are there other things you would like to say about these quilts? Children might say: I have a quilt my grandma gave me; I watched my grandmother and mother making a quilt; my mother quilts and she uses a sewing machine.



## *Connecting and Extending*

### **Introducing Vocabulary**

border	irregular shapes	regular shapes
corner	memories	scraps
diagonal	pattern	stitched
fabric	planned	template
horizontal	quilt	vertical





**Connecting and Extending  
continued...**

**Related Family Literacy Experiences**

Parents and children can:

- ✓ find a quilt that belongs to someone in their family and share its "history."
- ✓ go on a scavenger hunt and look for different patterns throughout the neighborhood.
- ✓ sew different items together using old fabric and cloth to make something meaningful.

**Books**

**Aunt Skilly and the Stranger** by Kathleen Stevens (Houghton Mifflin Company, 1994)

A thief makes the mistake of trying to steal homemade quilts from Aunt Skilly and her goose named Buckle.

**Luka's Quilt** by Georgia Guback (Greenwillow Books, 1994)

Luka and her grandmother disagree over the colors that should be in a quilt her grandmother is making.

**The Kindness Quilt** by Nancy Elizabeth Wallace (Marshall Cavendish, 2006)

A young girl makes a quilt that illustrates acts of kindness she performed.

**The Name Quilt** by Phyllis Root (Straus and Giroux, 2003)

Sadie enjoys hearing her grandmother talk about family members whose names are on a special quilt but becomes sad when the quilt blows away in a storm.



**Related Educational Experiences**

- ✓ Make a class quilt. The Office of Head Start Webcast Number Three *Patterns* includes a demonstration of the lesson with children using squares and rectangles to create a quilt.
- ✓ Have children 'piece' their own quilts on a large sheet of paper, covering it with small paper shapes (squares, rectangles, or triangles work best) and gluing or pasting the shapes in place.
- ✓ Have children sew plastic grids together with shoelaces or make holes in paper or fabric and "sew" or "piece" them together.

- ✓ Bring in quilts so children can see, feel, and experience the "real thing."
- ✓ Contact a local quilting guild. There may be a volunteer who could bring some quilts for children to see. Perhaps she or he could demonstrate piecing and quilting skills so children could see a work in progress as well as the finished product.
- ✓ See if children can find horizontal, vertical, and diagonal lines. Have children move one arm so it is horizontal (side to side, straight out from shoulder), vertical (up or down), and diagonal (at an angle). Then move the other arm so it is horizontal, vertical, and diagonal.

The ideas listed are just a few of the many activities that could be used to introduce or extend children's learning. Your knowledge of your children and families supports your ability to ensure positive learning experiences and outcomes for students. As an educator, you probably have ideas for books, songs, finger plays, and activities that you have thought of when introducing or extending children's learning related to the "A Head Start on Picturing America" artworks. We encourage you to confer with your colleagues, visit the local library or bookstore, and share your ideas with others.

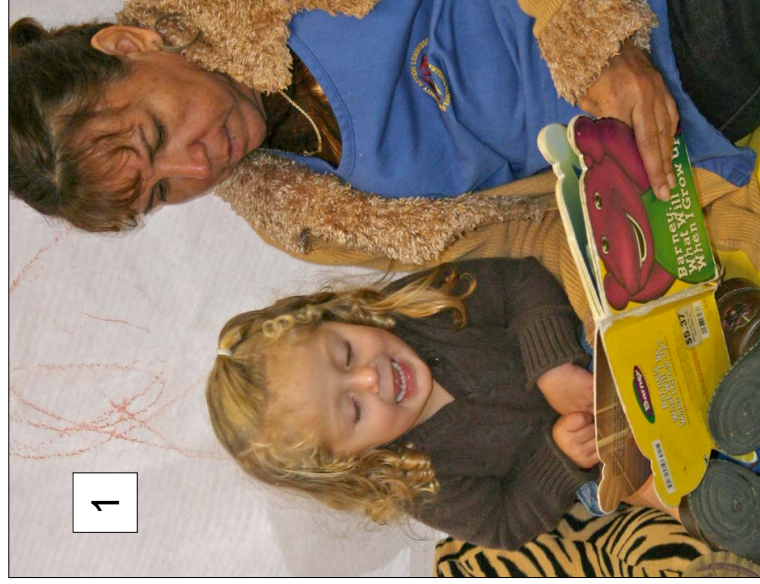




## Self-Assessment for Early Head Start Staff Patterns

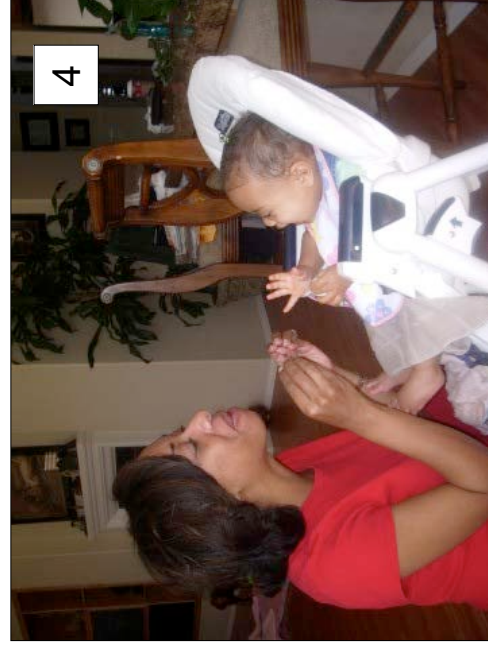
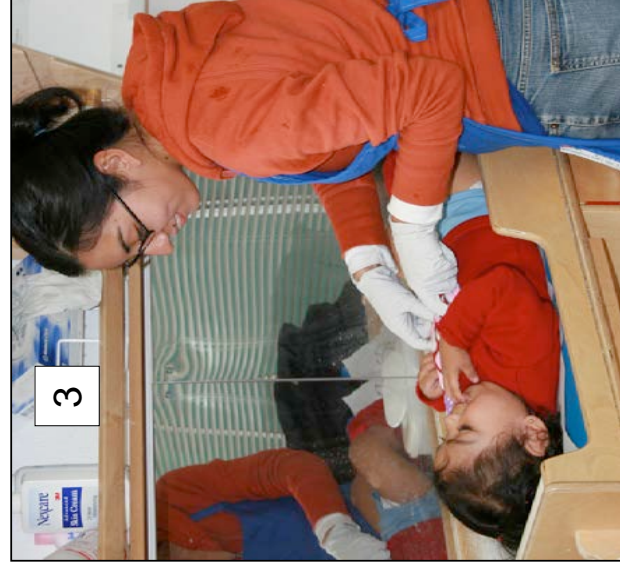
Skills for Adults Working with Children Birth-3 Years of Age	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
I know how our program's infant and toddler curriculum and assessment tools address sorting, matching, and patterning.	1	2	3	4	5
I understand what to expect infants and toddlers to know and be able to do related to patterns.	1	2	3	4	5
I develop and write teaching plans to engage babies and toddlers in multi-sensory experiences that support their matching, sorting, grouping abilities.	1	2	3	4	5
I recognize that routines are patterns in themselves and that routines help create a safe, secure environment for young children.	1	2	3	4	5
I know about and use resources to support children's developing knowledge and skills related to classifying, grouping, and patterning objects.	1	2	3	4	5
I mathematize or find the patterns in infants' and toddlers' daily routines and interactions.	1	2	3	4	5
I provide families with information, experiences, and vocabulary to use at home related to patterns, matching, and sorting.	1	2	3	4	5

# Where are the patterns? Discuss pattern-related concepts and vocabulary embedded in these everyday moments and interactions.



**Mathematize** means to bring out, or highlight, the math concepts during an interaction with a child or group of children. Adults can mathematize a child's experience by:

- using math language
- emphasizing math concepts
- posing math questions or problems to solve
- providing engaging materials and opportunities that support mathematical thinking





## Self-Assessment for Head Start Staff Patterns

Skills for Adults Working with Children 3-5 years of age	I am not skilled in this area	I am somewhat skilled in this area	I am highly skilled in this area
I know key indicators related to Patterns.	1	2	3
I understand what to expect children ages 3-5 to be able to do related to patterning, sorting, and organizing objects according to one or two attributes.	1	2	3
I use and write teaching plans that engage preschoolers in developmentally appropriate pattern experiences.	1	2	3
I mathematize or find the patterns in preschooler's daily routines and interactions.	1	2	3
I recognize and support emerging skills as children sort by, compare, and describe attributes (e.g., shape or color).	1	2	3
I use, and encourage children to use, language to describe patterns (e.g. repeating or growing) and attributes.	1	2	3
I provide families with information and experiences related to matching, sorting, and patterning to do at home.	1	2	3
I know where to find resources about children's developing knowledge and skills related to patterns.	1	2	3





## Math Webcast #5: Patterns Viewer's Guide for Math Leaders

### Key Points

Patterns can be established or recognized whenever outcomes are regular and predictable.

Patterns are a part of children's everyday experiences.

Pattern can be understood as an integrated part of numerous mathematical and non-mathematical curriculum domains.

### Part I: What do children need to know to understand patterns?

Give examples of identifiable, culturally significant patterns available children in your program.

What is the definition of a pattern?

Give an example of a repeating pattern. Give an example of a growing pattern. Explain why your examples are regular and predictable.

Explain how to improve a child's sense of predictability as it relates to patterns in various environments (i.e. the child's home, classroom, supermarket, etc.)

Why is it important for patterns to be a part of a young child's experiences?

Give an example of patterns that enhance children's learning experiences.

Give an example of how understanding patterns benefits the long-term education outcomes of children.

Pick two or more domains or domain elements from the Child Outcomes Framework and give examples of related lessons or experiences that would enhance a child's understanding of pattern.

Explain the process of:

- identification
- replication
- completion



Describe how a teacher can scaffold student's learning about and with patterns.

Choose two of the illustrated pattern experiences and give an example of how it could be used to enhance the learning experiences for children.

Give examples of ways teachers can facilitate students' discovery and description of patterns.

What are some other books, songs, etc. can teachers share with their students to illustrate a growing pattern? Pick one and describe how this book, song, etc. could be used?

Knowing what you know now, describe an activity incorporating or recognizing patterns in daily routines. How can teachers intentionally incorporate these activities?

How can teachers intentionally plan to incorporate learning about patterns into a child's daily routine?

Give three examples of children tacitly learning about patterns.

- 1.
- 2.
- 3.

How can the understanding of pattern inform or act as a precursor to a child's understanding of language, literacy, writing and science?

In terms of pattern, how is the teaching strategy for a young child different from that designed for older children?

## Part II: How?

How do the Head Start Child Outcomes Framework and the National Council of Teachers of Mathematics (NCTM) Prekindergarten Focal Points reflect the importance of teaching staff helping children learn about pattern?

Where do children learn about pattern?





### Part III: What Else?

What questions do you have about pattern and young children?

What strategies can teaching staff use to help children develop knowledge, skills, and understanding of pattern?

What can you do to help teachers in your program facilitate children's learning about pattern?





## Self-Assessment for Home-Based Staff Patterns

Skills for Adults Working with Parents and Children in Home-Based Program Option	I am not skilled in this area	I am somewhat skilled in this area	I am highly skilled in this area
<b>For Early Head Start:</b> I understand birth-to-three development related to patterns.	1	2	3
<b>For Head Start:</b> I know key Pattern indicators.	1	2	3
I help families feel confident in their ability to talk about patterns (e.g., growing and repeating) and attributes (e.g., size, shape, color) with their children.	1	2	3
I model how to find the patterns in families' daily routines, interactions, and environments.	1	2	3
I write and use teaching plans that engage children and families in multi-sensory, pattern experiences.	1	2	3
I provide families with information and age-appropriate pattern activities to do with their children.	1	2	3
I point out and discuss patterns and materials families have in their home (e.g., kitchen containers, dishes, tile, textiles, etc.) to support patterning.	1	2	3

## Patterns in Routines and Everyday Situations

Write your daily schedule or routine. Then, list as many connections to patterns as you can.

Remember that patterns are anything – events, objects, sounds, words, actions – that occurs in a predictable sequence. So, anything that is a routine is essentially a repeating pattern. You use the same or similar sequence of words and actions every bedtime, naptime or reading time, for example. Also, don't forget to look for patterns in the world around you and in the language learning and songs of early childhood.

Time	Routine, Activity	Connections to Patterns



# Measurement

*Measure children standing on the floor.  
One block, two blocks, three blocks, four.  
Longer, shorter, bigger, small.  
We're not the same, but we all stand tall.*





# Measurement

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## Introduction

In this chapter, we discuss the ways in which infants, toddlers, and preschoolers learn about measurement and how parents, teachers, and supervisors support that learning in the classroom and at home. Formally, measurement is the process of assigning a number to a measurable dimension, such as length or weight, using standard or non-standard units. Examples of standard units are inches and pounds. Non-standard units might be the length of your own foot or Unifix cubes. For young children, however, measurement is mostly about exploring and comparing measurable dimensions in the world around them.

Young children are just beginning to learn about measurement. Infants and toddlers notice and explore dimensions in their world such as size, weight, speed, and capacity. They begin to use language to describe these dimensions like “big”, “fast”, and “hot”. By the time they reach preschool age, children know quite a lot about measurable dimensions. They develop an informal understanding of measurement that involves evaluating and comparing things based on their dimensions. Preschoolers’ interest in measurement is reflected in their conversations and questions, for example, “I’m older than my brother.” or “Who is taller, me or Lexi?”



### Measurement Terms

- ◆ Non-Standard Measurement
- ◆ Standard Measurement
- ◆ Dimension
- ◆ Attribute
- ◆ Direct Comparison

*See Appendix for glossary.*

### Indicators for Measurement

- ◆ Shows increasing abilities to match, sort, put in a series, and regroup objects according to one or two attributes such as shape or size
- ◆ Begins to make comparisons between several objects based on a single attribute
- ◆ Shows progress in using standard and non-standard measures for length and area of objects



## Infant and Toddler Development

This section focuses on infants' and toddlers' development of measurement knowledge. First, read about the developmental highlights for infants and toddlers. Then, consider the ways in which teaching staff, home providers, and families can support learning in this area.

Infants and toddlers have many opportunities to learn about measurement during everyday experiences. Even before infants can move around, they experience concepts such as weight—as they try to pull a toy toward them; volume—as they attempt to wrap their tiny fingers around an object; and speed—as they kick their feet in response to music. Older infants and toddlers delight in opportunities to explore and talk about dimensions in their environment, such as weight, size, and speed.

### Infants and toddlers:

- ◆ Notice differences in size and other measurable dimensions, like temperature
- ◆ Explore objects that differ in size, weight, and capacity as they play; for example, trying to pick up objects that are very heavy or wrap their arms around a very large ball
- ◆ Begin to understand and use words like “Big!” and “Hot!”
- ◆ Begin to use language to make simple comparisons, like, “I’m big. My baby’s little.” (Sera & Smith, 1987)



## Learning About Measurement

Infants' and toddlers' growing awareness and understanding of dimensions in their environment are reflected in their actions and emerging language.

### For example:

- ♦ When an older infant requests "Up!", she stands close to her parent and stretches her arms upward
- ♦ Some toddlers refer to little objects as "baby" and bigger objects as "mommy" or "daddy"
- ♦ A toddler stacks blocks as high as he can reach and expresses excitement that he built something taller than himself
- ♦ During lunch time, a toddler recognizes when her bowl is empty and signs, "More?" or "All gone!"



## The Family Child Care Program Option

A family child care home is full of opportunities for children and adults to explore measurement together. Most homes are full of measurement tools. For example, in the kitchen there are measuring cups and spoons to use when cooking. Rulers, tape measures, and yard sticks can be used outdoors or indoors. Bathrooms often have scales for children to learn about weight.





## Adult Support for Infant and Toddler Development of Measurement Concepts



### Materials, Environments, and Experiences

For infants and toddlers, learning about measurable dimensions occurs during daily routines and playful interactions in their everyday environments. Adults can also plan simple experiences that help develop beginning ideas about measurement.

#### For example, adults can:

- ♦ Provide appropriate materials for children to explore and use, such as
  - ♦ toys of varying weights and sizes, like blocks and balls
  - ♦ a variety of different sized dolls and soft animals
  - ♦ nesting cups, containers, and measuring tools at sensory tables

### Language

As infants and toddlers begin to learn language, adults can support both their concept and vocabulary development through interactions and conversations. Follow the child's lead to make words and ideas meaningful and contextualized. Take advantage of opportunities to mathematize and narrate using descriptive language related to size, weight and other measurable dimensions.

#### For example, adults can:

- ♦ Draw children's attention to the differences in size between a child and a block tower, "You are taller than your tower!"
- ♦ Discuss taking sand out of a bucket to make it light enough to pick up, "That bucket is heavy. Let's take some out to make it lighter."
- ♦ Use comparison language, such as *bigger*, *taller*, *smaller*, *heavier*, *lighter*, *hotter*, *colder*, *slower*, *faster*
- ♦ Emphasize dimensions, like size, when reading books (Rivera, et al., 1994) and telling stories



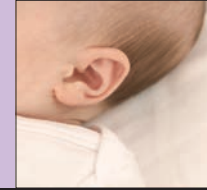
"Look, here's a *tiny little mouse* and here's **a great big elephant.**"



## Adult Support for Infant and Toddler Development of Measurement Concepts



### *Look for and listen to Measurement experiences and interactions in Early Head Start Programs*



Infant/Toddler Center-Based Classrooms and Family Child Care Homes	Home-Based Option Family Settings
Toddlers Mary and Juan stack and line up different sizes of foam blocks on a rug. Teacher joins them and comments, "You have some long blocks and some short blocks."	The home visitor picks up Baby Gita and say, "Oh, you're getting so heavy! I think you've grown."
Infant Misty sits on the rug looking around. Then she reaches out toward the stacking rings. Teacher moves the rings closer to her so she can play with them and says, "Here's the big ring."	Terry's grandma arrives. She has brought him a child-size chair in which he immediately sits down. Grandma says, "It's just your size! I'll sit in this big chair. It's just <i>my</i> size."
Atiyah plays with baby dolls of different sizes. She puts the little one in the crib and the big one in the stroller. Then she takes the baby out and tries to fit in the stroller herself.	The child, parent, and home visitor sit together on the floor and look at the big book of <i>Goodnight Moon</i> by Margaret Wise Brown. On each page, the home visitor asks, "Where is the tiny mouse?"
Children and teachers roll different sized rubber balls back and forth in gross motor areas and outside.	A "How Tall Am I?" chart on the bedroom wall marks children's heights over a period of time. Mario and Isabel show the Home Visitor how tall they are. Mario says, "I'm the tallest."
Teachers bundle up the children to go outside. One teacher says, "It's <i>very</i> cold out today. You need your hat and mittens!"	Mom, Shawnte, and Charise use measuring cups, spoons, and other utensils in the kitchen as they make cookies together. Mom says, "Let's use a bigger cup to measure the flour."





## Preschool Development

This section focuses on preschoolers' developing measurement knowledge. First, read about the general progression of preschoolers' understanding of measurement concepts. Then, consider how teachers, home providers, and parents can support learning in this math area.

Children enter preschool with informal, experience-based ideas about measurement to build upon, explore, and refine. They are keenly interested in objects that differ in size, height, weight, volume, and other dimensions.

### Preschoolers:

- ◆ Make direct comparisons; for example, standing back-to-back to see who is taller or holding a rock in each hand to find out which is heavier
- ◆ Increasingly use comparison language to describe objects, people, and events; for example, taller/tallest, faster/fastest, heavier/heaviest
- ◆ Explore non-standard measurement tools, for example, feet, paperclips, Unifix cubes, and paper cups
- ◆ Explore standard measurement tools, for example, measuring cups, balance scales, and measuring tapes
- ◆ After many experiences, they begin to learn to measure by using number (e.g., moving a finger along a row of blocks and counting to see how long it is)

### Comparison Strategies

Preschoolers and children in early elementary school develop measurement strategies in a general sequence moving from

- ◆ Perception-based (visual) to
- ◆ Direct comparison to
- ◆ Quantitative (number)

*My foot looks bigger!*

*When I put my foot next to yours, my toes reach further!*

*My foot is 8 inches long, 2 inches longer than yours!*

## Learning About Measurement

Young children's understanding of measurement is grounded in their real-life experiences. They are very interested in exploring measurement in a variety of ways, including using tools like rulers and scales.

- ♦ A child plays with rocks in the science center and says, "This rock is so heavy!"
- ♦ Children in the dramatic play area discuss family roles based on size, "You are the baby because you're smaller. I'm the mommy because I'm bigger."
- ♦ During lunch time, children talk about differences in amounts of food on their plates and how much milk they have
- ♦ Children use a measuring tape to measure the length of their block road



"Young children know that properties such as length exist early, but they do not initially know how to reason about these attributes or to measure them accurately."  
- Sarama & Clements, 2009, p273

## Length, Height, Width, and Area

Preschoolers enjoy measuring distances and area using non-standard measurement tools such as lengths of string, links, and even their own hands. They also benefit from opportunities to explore standard measurement tools such as measuring tapes, rulers, and scales. However, it will not be until they are in elementary school that they will truly grasp what standard units of measure represent.

Practicing and experimenting is important for all children's development. A preschool classroom supports measurement experimentation when it contains, for example, blocks of different sizes and other non-standard measurement tools, like Unifix cubes. These, along with standard measurement tools, should be available throughout the classroom for children to use.

### Preschoolers:

- ◆ Measure a rug with a measuring tape, point at a number, and say, "It's seven!"
- ◆ Build towers using inch cubes, compare theirs to another child's, and say, "Mine is 4 taller than yours."
- ◆ Place two smaller shapes together to make a bigger shape
- ◆ Paint at the easel, covering all or part of the surface area of the paper



### A Home-Based Program Option

Many standard and non-standard measurement experiences can be planned for parents to do at home with their children.

For example, children's feet can be traced and cut out, then used to measure items in the home. At the next group socialization, measuring with feet can be continued with all participants measuring items in the classroom.



## Weight

Children are intrigued by the differences in weights of objects that are similar in size. For example, they are surprised when holding a small rock in one hand and a large rubber ball in the other, that the rock is heavier than the ball. They also like to show how strong they are by picking up big things while helping to clean up.

Teachers can respond to children's interests by planning experiences that allow children to make comparisons. A balance scale provides a concrete way for children to independently explore differences in weight and supports early learning of number comparison. Providing many different materials close to the balance scale leads to independent exploration.

### For example:

- ♦ A child places five rocks in one basket of a balance scale and five cotton balls in the other and wonders why the side with rocks goes down
- ♦ A child places five counting bears in one side and six counting bears in the other and notices that six must be heavier than five because the side with six goes down

### Engaging Families

Children learn best when teaching staff and parents work on similar tasks. Ask parents if they have unique measurement tools used in their homes. If possible, find examples of these tools and place them throughout the classroom.

For example, one family might send an old-fashioned scale to school, another might send a sand timer. Encourage parents to talk about these items with their children or send them to school for all to experience and enjoy.



## Volume and Capacity

Capacity and volume are measurable dimensions that children often experience in their play with different materials. Capacity, or how much a container can hold, is explored at the water table or sand box as children see how much water or sand can fit in different sized containers. Volume is the space that a solid object or liquid takes up. Talking with children about capacity and volume, using descriptive language and asking questions, helps them develop an understanding of these dimensions.

### Examples of children exploring capacity and volume:

- ♦ During a cooking activity, children help measure the dry and liquid ingredients
- ♦ Children pour the water from one container into another to see which holds more
- ♦ Children stack blocks on the shelves and notice how many blocks fit in each space
- ♦ Sing the alphabet song to measure that a child has washed their hands for a sufficient length of time

In a 4-year-old classroom, the teacher does a demonstration using cotton balls and a bowl of water. She soaks one cotton ball in water, then squeezes out the water and asks the children whether a little water or a lot of water came out. Then she asks, "What do you think will happen if I use *a lot* of cotton balls? Will there be more water or less water or will it be the same?"

After the demonstration, children have the opportunity to investigate cotton balls and water on their own.



*"Children's understanding of measurement has its roots in infancy and the preschool years, but grows over many years."*

- Sarama & Clements,  
2009, p279



## Time

Preschool children think of time in terms of their own experiences. It is important to remember that time is an abstract idea for them at this age. By explaining the passage of time in a meaningful manner, teachers help children develop a deeper understanding of this concept.

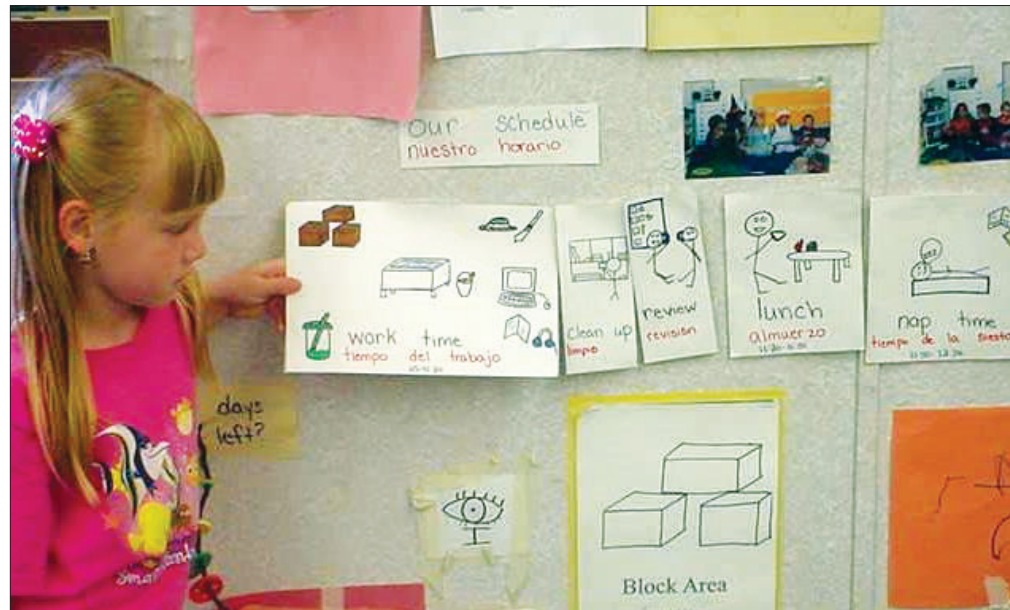
### Examples of developmentally appropriate experiences:

- ◆ Post a child-friendly daily schedule and refer to it throughout the day
- ◆ Use consistent transitions (such as two-minute warnings)
- ◆ Talk about yesterday, tomorrow, and next week
- ◆ Discuss past and future birthdays, “when I was a baby”, and “when I grow up”
- ◆ Sing the alphabet song to measure how long someone has washed their hands



*“Concrete representations of time passing, such as sand running through an egg timer, help children get a sense of how long a given period of time is.”*

- Copley, 2000, p134





## Adult Support for Preschool Development of Measurement Concepts



### Materials, Environments, Experiences, and Language

Children begin using measurement language at a very young age. It develops from using one or two general measurement words (e.g., big, hot) to learning exact words for specific concepts. For example, young children often use the word “bigger” to describe things that are taller, wider, older, or more in quantity. As they hear teachers use new descriptive words related to these ideas, they learn to discriminate between various measurement concepts and can more accurately describe what they see. When teachers mathematize experiences through frequent use of rich or “juicy” words, they support children’s vocabulary as well as math learning.

#### For example, adults can:

- ◆ Provide materials that encourage children to explore measurement, like standard and non-standard measurement tools
- ◆ Use language that compares quantities (more than, less than, same as, etc.)
- ◆ Use measurement terminology to identify differences in attributes (longer, shortest, heavier, lightest, etc.)
- ◆ Suggest measurement strategies when children compare size, capacity, weight, and other dimensions

*“Teachers are fundamental to the development of young children’s mathematical abilities. They are the architects of the environment, the guides and mentors for the explorations, the model reasoners and communicators, and on-the-spot evaluators of children’s performances.”*

- Greenes, 1999, p46



## Adult Support for Preschool Development of Measurement Concepts



### *Look for and listen to Measurement experiences and interactions in Head Start Programs*



Preschool Center-Based Classrooms and Family Child Care Homes	Home-Based Option Family Settings
Tina and T.J. use a balance scale to compare the weight of items such as counting bears, shells, rocks, and cotton balls.	Terry and the home visitor sing <i>The ABC Song</i> as he washes his hands to make sure he's washing them long enough.
Teachers provide measuring tapes to children in the block area so they can measure their constructions.	Lucas and his dad comment on how heavy the home visitor's bag is today. Lucas tries to lift it and Dad asks, "What's making it so heavy?" The home visitor takes out a pile of new books to share.
In the library corner, Teacher reads <i>How Big is a Foot?</i> to a small group of children. "Let's use our feet to measure the circle time rug."	Mario and his little sister Isabel have the bathroom scale out in the front room. They take turns getting on and off the scale. Their mom and home visitor help them read the number and talk about how much they weigh.
Children and teachers discuss quantities as children serve, pour, and eat during mealtimes.	The home visitor, Mimi, and her mom have been singing "Five Little Ducks". The home visitor asks, "How far away do you think those little ducks went?"
Bobby is playing at the water table with different sized cups and bottles. Teacher observes him using a small cup to fill a big bottle.	The home visitor and Terry make a paper-clip chain with 5 large sized paper clips. Then they hunt around the house to find objects that are the same length. They find lots of items that are longer and shorter, too, and talk about it.




## Language is Key—Birth to Five

Here are two Measurement scenarios featuring the *Follow the CAR* dialogic strategies. The strategies require adults to follow the child's lead and give the child time to talk. This encourages longer, richer conversations about children's interests and is a perfect opportunity to mathematize children's experiences.

### Infant/Toddler Scenario

Teacher Russell sits on the floor near toddlers, Shawnte and Danny. Shawnte grabs the doll Danny is holding. Danny yells, "Noooooooooooo!" Knowing that distraction and redirection work well with active toddlers, Russell asks them a question.


(ASK) Russell asks, "Is that doll as big as Shawnte? As big as Danny?" The two toddlers stop and turn toward their teacher. He pauses and waits while they consider his questions.

 **Follow the CAR**

**Follow the child's lead and then:**

- ⇒ Comment and wait, or
- ⇒ Ask question and wait, or
- ⇒ Respond by adding a little more and wait, or
- ⇒ When speaking in the home language and a child says a word in English, repeat the word in the home language

*Language Is the Key—Follow the CAR* is a multimedia resource distributed by the National Head Start Family Literacy Center. If your program does not have the book and DVD already, email [info@wlearning.com](mailto:info@wlearning.com).



(FOLLOW) Shawnte lifts the doll above her head, then holds it toward Russell. Both toddlers watch intently as he measures the doll against Shawnte and then against Danny. They are now engrossed in measuring and have forgotten their argument.

(COMMENT) Russell says, "Shawnte and Danny are both bigger than the doll." Shawnte smiles and looks at Danny. Russell pauses and waits for either toddler's response.

(ASK) After about five seconds Russell says, "Shawnte, would you like to measure Danny with the doll?" He passes the doll to Shawnte and waits. She holds the doll and watches Russell. After a few seconds he says, "Can I help you?" Together they hold the doll against Danny. Russell says, "Danny, would you like to measure Shawnte?" Danny holds it against Shawnte. Russell pauses again and waits to see what they will do.

(RESPOND) Shawnte loses interest in the doll and moves away toward the blocks. Danny has the doll back. He holds it tight and says, "Baby." Russell responds by adding a little bit more, "Yes, Danny. A baby doll." Danny smiles and hugs the doll closer.





## Preschool Scenario

Home Visitor Sukie arrives at the Johnson door prepared to intentionally mathematize her visit.

(COMMENT) Sukie says, "My goodness Nathan! I think you are taller than last week!" Mr. Johnson says, "Nathan eats all his vegetables because he wants to be a big, strong boy." Nathan jumps up and down and says, "See how high I can jump?"

(RESPOND) "Yes, up to the window," Sukie responds. Then Nathan jumps again saying, "I can jump higher than the window!"

(FOLLOW) "You're legs and feet must be really strong! I have a neat idea. Let's do some measuring with those big, strong feet of yours. Does that sound like fun?" Nathan nods his head vigorously.

(COMMENT) Sukie says, "We will draw your feet on paper and measure with them—and then we can measure using a ruler."

(COMMENT) After Nathan and his dad trace and cut out paper feet, Sukie comments, "Your paper feet are pretty big." She pauses and waits for Nathan to respond.

(ASK) When Nathan doesn't respond after about five seconds, Sukie asks, "Are your feet as big as your dad's feet?" Nathan holds the paper feet up to his dad's foot and says, "Two feet make the same as yours, Dad!" Mr. Johnson says, "Nathan loves to see how big things are."

(ASK) After waiting a few seconds, Sukie asks, "Can you measure something else using your paper feet?" Nathan walks over to the TV. Mr. Johnson helps Nathan measure and he says, "Four paper feet!" Sukie smiles and waits while Nathan runs around the room, measuring various items with his paper feet.

(ASK) When Nathan slows down, Sukie asks, "Would you like to measure using a ruler now?" "Yes!" says Nathan. Sukie shows Nathan the numbers on the ruler to Nathan and he runs off to measure things in the room.



### Follow the CAR

Follow the child's lead and then:



- ⇒ Comment and wait, or
- ⇒ Ask question and wait, or
- ⇒ Respond by adding a little more and wait, or
- ⇒ When speaking in the home language and a child says a word in English, repeat the word in the home language







## Ongoing Monitoring, Supervision, and Professional Development



## Introduction

This section of the resources will help ensure that Head Start and Early Head Start programs are providing high quality experiences and individualized instruction related to key indicators for Measurement. The first step in this process is to gather information about your program through observation, self-assessment, ongoing monitoring, and child- outcomes data. Next, educational leaders need to analyze the information collected to come to conclusions about program-wide as well as individual-teachers' needs. Finally, decisions must be made about the training or supervisory approaches best suited to the needs, culture, strengths, and learning styles of your staff.

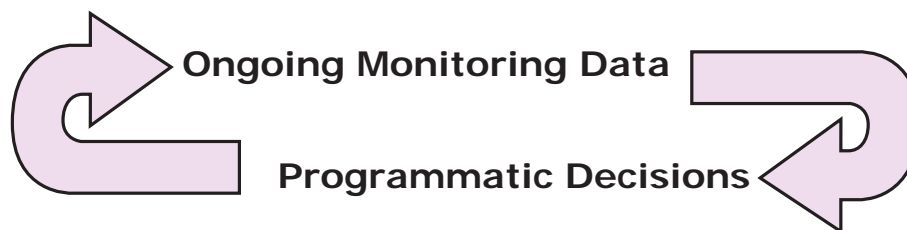


### The following pages contain resources about:

- ◆ Data collection through ongoing monitoring, classroom observation, and program self-assessment
- ◆ Mentoring and reflective supervision to support reflective practice and professional development
- ◆ Ongoing support of infant, toddler, and preschool children's development in the area of Measurement
- ◆ Professional development tools to support staff in center-based, family child care, and home-based program options

## Using Data from Ongoing Monitoring to Make Decisions

Head Start and Early Head Start programs are faced with the ongoing task of making decisions—both small and large—to ensure positive outcomes for children. Answers to challenges may surface quickly and be easily put into practice. Other times a more thorough approach is needed to define a problem, decide upon a solution, and plan for implementation.



The High Five Mathematize Guide is meant to help Head Start and Early Head Start leaders to 1) become more familiar with child development in the area of mathematics, 2) find out about the math strengths and needs of children and program staff, and 3) provide professional development tools to meet those needs, and capitalize on existing strengths.

The following page provides four categories with questions to help organize an approach to decision-making about math teaching and learning. The categories are:

- ◆ Staff Behaviors and Teaching Practices
- ◆ Learning Environments and Materials
- ◆ Child Behaviors
- ◆ The School-Home Connection

In addition to this guide, there are dozens of Program Planning resources on the Early Childhood Learning and Knowledge Center (ECLKC) website at <http://eclkc.ohs.acf.hhs.gov>, as well as observation tools such as those listed to the right.

### Tools to Guide Observation and Monitoring

1. SOLAR Infant/Toddler Classroom Staff Skill Profile (See Appendix)
2. OHS Math Environmental Scan (See Appendix)
3. OHS Math Measurement Webcast #4
4. OHS Monitoring Protocol: Education and Early Childhood Development

## Using Data from Ongoing Monitoring to Make Decisions

Ongoing monitoring, classroom and staff observations, and even informal classroom visits, provide opportunities to look for behaviors and environmental factors that support positive outcomes for children.

### Staff Behaviors and Teaching Practices

- ♦ Are staff creating learning experiences and environments to ensure children encounter measurement throughout their day?
- ♦ Are both planned and spontaneous measurement conversations taking place that are responsive to children's questions and interests?
- ♦ Describe how staff use "math talk" or otherwise mathematize children's everyday moments to highlight a wide variety of measurement concepts.
- ♦ How do staff involve families or guardians in measurement experiences?

### Learning Environments and Materials

- ♦ Do the learning environments (indoor and outdoor) have a wide variety of materials available for learning about and exploring measurement?

### Child Behaviors

- ♦ Are children engaged in, talking about, and exploring: measurement concepts, measurement tools, measurement questions or problems?
- ♦ How does the ongoing observation and child assessment information inform teachers' planning?

### The Home-School Connection

- ♦ Is information shared with families about how to support measurement at home?
- ♦ Is math a part of family-education or parent meetings?
- ♦ Are families encouraged to think of themselves as mathematicians in the course of their daily lives and empowered to help their children learn?



"Oh! Look how tall this plant is now! It is 1 inch taller than it was a few days ago! It's growing quickly."

## Mentor Coaching and Reflective Supervision

Mentor-coaching and reflective supervision can help teaching and home visiting staff improve their professional practice. The mentor-coaching skills in the boxed-list are not specific to measurement, or any other child outcome. They are general skills for supervisors and mentors to consider and employ.

Read the following examples to see how these skills can support staff and ultimately lead to positive measurement outcomes for children.

*Jose, a site supervisor, asked his teaching staff to complete the Measurement Self-Assessment\*\*. He used the tool to support staff in developing their own professional development goals.*

To build community at an all-staff training, the Training Director asked everyone to share one chore or activity they'd done the previous weekend. Then, the group had to "find the measurement" in the list.

*An Education Manager modified the OHS Math Environmental Scan so it focused on measurement. Then she carefully paired teachers from different sites and had them do the Scan in each other's classroom and share the results.*

A teacher was confused about an item on the assessment tool regarding non-standard versus standard measurement. The teacher asked her colleagues and supervisor for support so she could accurately observe, assess, and plan for instruction.

### Mentor-Coaching Skills\*

- ◆ Professional Development Planning
- ◆ Setting Achievable Goals
- ◆ Problem Solving
  
- ◆ Relationship Building
- ◆ Sharing Values
- ◆ Culturally Sensitive Approaches
- ◆ Self-Reflection
- ◆ Communication, Listening, and Reflective Inquiry
  
- ◆ Observation and Use of Observation Tools
- ◆ Reflective Conferencing
- ◆ Journaling
- ◆ Providing and Receiving Feedback
  
- ◆ Child Assessment
- ◆ Individualizing Instruction

*\*See Appendix for additional resources about Mentor-Coaching.*

*\*\* The Self Assessments are located at the end of this chapter.*



## Self-Assessment for Early Head Start Staff

	Measurement					
	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area	
<p>This self-assessment* can be completed by Education Managers, supervisors, and/or teaching staff.</p> <p>The information can be used, in a non-evaluative way, to make decisions about topics for program-wide training or on an individual level with staff to provide tailored mentor-coaching or reflective supervision.</p> <p>The self-assessment may also help staff identify their own professional development goals.</p> <p>Page ahead to find additional self-assessments to use with Head Start staff and home-based staff.</p> <p><i>*See the end of the chapter for full-size versions of the Measurement Self-Assessments.</i></p>	<b>Skills for Adults Working with Children Birth-3 Years of Age</b>					
	I know measurement-related content and terminology in the program’s infant and toddler curricula and assessment tools.	1	2	3	4	5
	I understand what to expect infants and toddlers to know and be able to do related to measurement and comparing.	1	2	3	4	5
	I write and use teaching plans that engage babies and toddlers in multi-sensory measurement-related experiences.	1	2	3	4	5
	I provide a variety of materials, manipulatives, objects, and toys that support learning about size, weight, length, and other measurement concepts.	1	2	3	4	5
	I know about and have access to a variety of resources to support children’s developing knowledge and skills related to measurement.	1	2	3	4	5
	I recognize or find the measurement in infants’ and toddlers’ daily routines and interactions.	1	2	3	4	5
	I provide families with information, activities, and measurement experiences to do at home.	1	2	3	4	5

## Professional Development

### Ideas for Staff Working with Infants and Toddlers

**Mathematize** means to bring out, or highlight, math concepts during an interaction with a child or group of children.

Adults can mathematize in a variety of ways. However, the first step in mathematizing is *to recognize* the math concepts that are embedded in what children are exploring or experiencing.

To help staff think about math in children's play, give small groups a full-size handout\* (at right) with the four photographs of infants and toddlers. Remind and encourage staff to focus on measurement. After they've had time to discuss and brainstorm, write their responses on a flipchart.

#### You may hear responses, such as:

- ♦ Photo 1: *size* of Sippy cup, *volume* of liquid in Sippy cup, *distance* between caregiver and baby's face, etc.
- ♦ Photo 2: *circumference* of the ball, *weight* of the ball, *size comparison* of the boy versus the ball, *loud* or *soft* sounds the little balls make inside the big ball
- ♦ Photo 3: *distance* baby has to reach for ring, *varying sizes* of the rings, etc.
- ♦ Photo 4: *amount* or *volume* of sand in pink versus yellow container, *weight* of full versus empty container, *height* of sand table, etc.

**Where's the measurement?** Discuss measurement concepts and vocabulary related to what these infants and toddlers are doing.



**Mathematize** means to bring out, or highlight, the math concepts during an interaction with a child or group of children. Adults can mathematize a child's experience by:

- using math language
- emphasizing the math concepts
- posing math questions or problems to solve
- providing engaging materials and opportunities that support mathematical thinking

*Where's the measurement?* is a training tool that gives staff or families an opportunity to "put on their math glasses" and look for measurement concepts, vocabulary, and opportunities in the photographs.

\*A full-size handout is available at the end of this chapter.

## Professional Development

### Ideas for Staff Working with Infants and Toddlers

Another excellent training approach is to have staff analyze and discuss video clips of children in action. The measurement folder on your DVD has two infant/toddler video clips called "Linden Sorts the Laundry" and "Baby and Ball". Both videos can be used for small or large group trainings or during parent meetings.

#### "Linden Sorts the Laundry"

Before watching the clip of Linden, prime your audience to watch for and think about the measurement or measurement-related learning that could be happening. You may want to watch the video more than once.

After watching the clip, use questions such as the following to facilitate a discussion.

- ♦ What did you see?
- ♦ What measurement or measurement-related ideas does he demonstrate?
- ♦ What might he be learning?
- ♦ How might you mathematize or highlight the measurement in the moment for Linden?



#### "Baby and Ball"

Before watching the clip of Ford, remind your audience to watch for measurement or measurement-related learning that could be happening. You may choose to watch the video multiple times.

After watching the clip, use or modify questions such as the following to facilitate a discussion.

- ♦ What did you see?
- ♦ What measurement or measurement-related ideas does he demonstrate?
- ♦ What might he be learning?
- ♦ Did adults mathematize or bring out measurement concepts during this playful interaction with Ford?

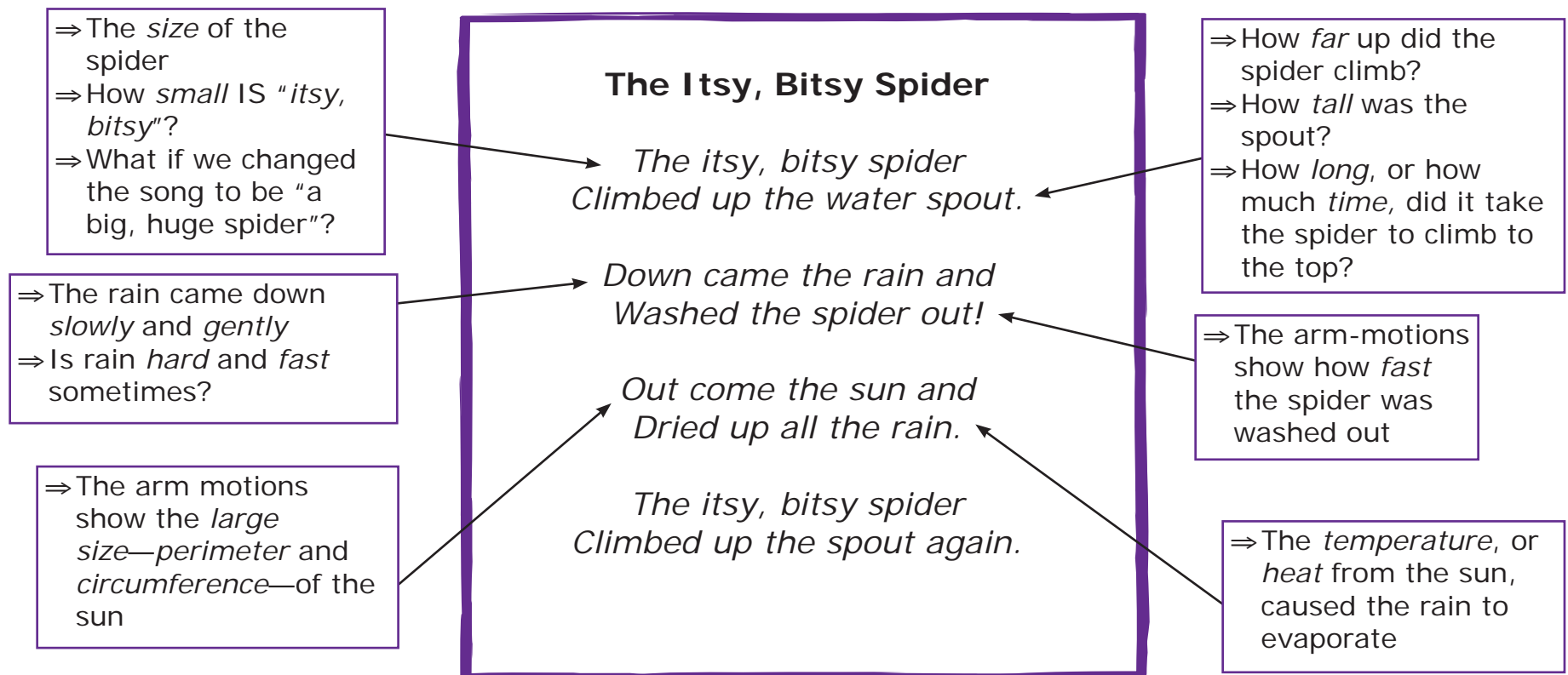


## Professional Development

### Ideas for Staff Working with Infants and Toddlers

Ask staff to find the measurement or mathematize early childhood books, songs, and finger plays. Try using a popular children's song or finger play like "The Itsy, Bitsy Spider" to start with. Or you may want to choose a more culturally or linguistically relevant song.

Provide the lyrics and then sing the song with staff; make sure to do all the accompanying hand and arm movements. Here are examples of measurement-related ideas, vocabulary, and questions Head Start staff might share about "The Itsy, Bitsy Spider".



## Self-Assessment for Head Start Staff

This self-assessment\* can be completed by Education Managers, supervisors, and/or teaching staff.

This non-evaluative assessment information can assist in decision-making about professional development for all staff meetings, site-based trainings, or individual staff.

*\*See the end of the chapter for full-size versions of the Measurement Self-Assessments.*

Skills for Adults Working with Children 3-5 years of age	Measurement				
	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
I know the key indicators related to Measurement.	1	2	3	4	5
I understand what to expect preschool children to know and be able to do related to measurement and comparing.	1	2	3	4	5
I write and use teaching plans that engage preschoolers in developmentally appropriate measurement experiences.	1	2	3	4	5
I can mathematize or find the measurement in children's daily routines and interactions.	1	2	3	4	5
I can recognize and describe different strategies that children use to compare height, area, weight, volume, etc.	1	2	3	4	5
I understand the difference between non-standard and standard measurement.	1	2	3	4	5
I provide families with information, activities, and measurement experiences to do at home.	1	2	3	4	5
I know about and have access to a variety of resources about children's developing knowledge and skills related to measurement.	1	2	3	4	5



## Professional Development

### Ideas for Staff Working with Preschoolers

**Mathematize** means to bring out, or highlight, math concepts during an interaction with a child or group of children.

Adults can mathematize in a variety of ways. However, the first step in mathematizing is *to recognize* the math concepts that are embedded in what children are exploring or experiencing.

To help staff think about measurement in children's play, give small groups a handout\* (at right) with the four photographs of preschool children. After they've had time to discuss and brainstorm, write their responses on a flipchart.

#### You may hear responses, such as:

- ♦ Photo 1: *water temperature, size of the space between the girl, sink, and wall, etc.*
- ♦ Photo 2: *distance children stand from the basket, circumference of the basketballs, height of the hoop versus the children, etc.*
- ♦ Photo 3: *speed of the toy car going down the ramp, length of the ramp, height of the ramp above the ground, etc.*
- ♦ Photo 4: *little girl using measuring spoons, may be pretending that the temperature of the stove is hot, waiting a certain amount of time for the food to be finished cooking, etc.*

**Where's the measurement?** Discuss measurement concepts and vocabulary related to what these preschoolers are doing.



**Mathematize** means to bring out, or highlight, the math concepts during an interaction with a child or group of children. Adults can mathematize a child's experience by:

- using math language
- emphasizing the math concepts
- posing math questions or problems to solve
- providing engaging materials and opportunities that support mathematical thinking



*Where's the measurement?* is a training tool that gives staff or families an opportunity to "put on their math glasses" and look for measurement concepts, vocabulary, and opportunities in the photographs.

\*A full-size handout is available at the end of this chapter.

## Professional Development

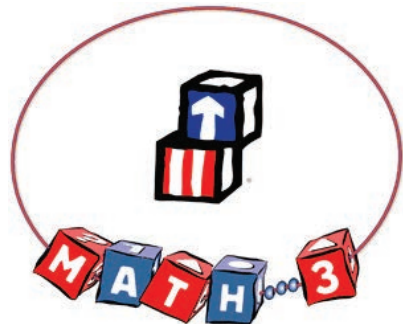
### Ideas for Staff working with Preschoolers

The Office of Head Start, with the help of Early Childhood Math professor, Dr. Juanita Copley, created a series of math webcasts. The OHS Measurement Webcast #4 is designed with education leaders in mind. If you have not watched it, make a point to do so with your leadership team; the webcasts are available on the Early Childhood Learning and Knowledge Center (ECLKC) website at <http://eclkc.ohs.acf.hhs.gov/hslc>.

Along with the full-length Webcast #4, the ECLKC has created “video lessons” about measurement. Each video lesson features a video of adults and children interacting as well as a narrative text that describes what happened before the lesson, during the lesson, and follow-up after the lesson is over. *See example at right.*

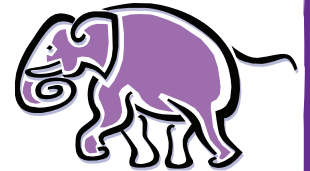
Invite staff to watch the video lessons with their teaching teams or host a working-lunch to watch, discuss the videos, and share their own successful approaches. Another option is to show the video lessons throughout the year during in-service or training days.

#### Measurement video lessons available on the ECLKC:



- ♦ Sand Babies I
- ♦ Sand Babies II
- ♦ Walking the Circle
- ♦ Elephant Feet
- ♦ Balloon Rocket
- ♦ Car Racing
- ♦ Measuring the Fruit
- ♦ Conservation Task

#### Measurement (Webcast #4) Elephant Feet Lesson



The video shows Dr. Copley with a group of children and a paper cut-out of her grandbaby’s foot. Then she shows a cut-out of her *own* foot, and finally, she shows a picture of a cut-out of an elephant foot from Steve Jenkins’ book *Actual Size*.

Then, with the children’s help, Dr. Copley measures her height using the different sizes of feet. Her height is VERY different if she measures with baby feet, her own feet, or elephant feet!

Finally, children have a chance to measure their height.

### Ideas for Staff working with Preschoolers

Help or encourage staff to use children's literature as a springboard for piquing children's interest, starting conversations, and creating extension activities about size, length, volume, time, weight, speed, temperature, or any other measurable dimension. Share the following information via email or during a meeting.

### Finding the Measurement in the Story *The Three Bears*



#### Comparing and Matching Sizes

As you read, point out the relative sizes of the bears and each of their possessions. Describe the bowls, spoons, chairs, and beds using comparative language. "That's Papa Bear's bowl. It's big, like he is!" Ask children to identify which bowl, spoon, chair, and bed belongs to each bear and to explain their answers.

Size is not the only dimension involved in the story; temperature, speed, time, and hardness are discussed as well. After you have read the story through, go back and discuss some of these dimensions. "Whose porridge was the hottest? How long do you think the bears were gone? Is your bed too hard, too soft, or just right?"

#### Seriating by Size and Other Dimensions

Use flannel board pieces or other props to act out the story of *The Three Bears* as you read. Allow children to arrange items in graduated order. Bring seriation into each classroom learning area by including items of three or more sizes (e.g., different size animals and blocks in the block area, differently weighted items in the water table, different size shovels and funnels in the sand table, etc.).

#### Look for other children's books featuring measurement:

- ♦ **My Very First Look at Sizes** by Christiane Gunzi; Spanish Edition: **Mi Primera Mirada a los Tamaños**
- ♦ **Inch by Inch** by Leo Lionni; Spanish Edition: **Pulgada a Pulgada**
- ♦ **I'm Too Big/Soy Demasiado Grande** by Lone Morton
- ♦ **Actual Size** by Steve Jenkins; Spanish Edition: **Tamaño Real**
- ♦ **How Big Is a Foot?** by Rolf Myllar
- ♦ **Who Sank the Boat?** by Pamela Allen

## Self-Assessment for Home-Based Staff

This self-assessment\* can be completed by Education Managers, supervisors, and/or teaching staff.

This non-evaluative assessment information can assist in decision-making about professional development for all staff meetings, site-based trainings, or individual staff.

*\*See the end of the chapter for full-size versions of the Measurement Self-Assessments.*

Skills for Adults Working with Parents and Children in Home-Based Program Options	Measurement				
	I am not skilled in this area		I am somewhat skilled in this area		I am highly skilled in this area
I know the key Measurement indicators.	1	2	3	4	5
I understand what children should know and be able to do at this age related to measurement and comparing.	1	2	3	4	5
I help parents and guardians feel comfortable and confident in their ability to mathematize or talk about simple measurement ideas.	1	2	3	4	5
I model how to find the measurement in families' daily routines and interactions and environments.	1	2	3	4	5
I develop and/or use teaching practices that engage children and families in multi-sensory, measurement experiences.	1	2	3	4	5
I provide parents or guardians with information, activities, and measurement experiences to do with their children.	1	2	3	4	5
I point out and discuss safe measurement tools and materials families already have in their home.	1	2	3	4	5



## Professional Development

### Ideas for Staff Working in Home-Based Program Options

Head Start and Early Head Start staff who conduct home-visits are in the unique position to support both children and families simultaneously. Have home visiting staff analyze and discuss how they might use the following resources or approaches during a home visit to encourage positive child outcomes in measurement.

I can double or halve a recipe.	I am good at putting together or building furniture.	I can choose the line at the grocery store that will take the least time to get through.	I know my height in English (inches) and Metric (centimeters) system.
I am good at parallel parking.	I put dishes away in a particular way.	I know what phase the moon is in.	I knit, bead, or crochet.

### Everyday Math

Help adults recognize all the measurement they do and are good at in their daily lives by talking through or playing *Everyday Math Bingo*.<sup>\*</sup> A shortened version is shown here (left). When parents start finding the measurement in their everyday lives, they will be better able to share their measurement-related knowledge and language with their children.

### Measurement Scavenger Hunt

Home visitors can have children and adults go on a measurement scavenger hunt that focuses on making direct comparisons. The activity can be modified or extended to focus on weight, width, area, temperature, etc. This example focuses on height. Simply ask parents and children, as a team, to find:

- ♦ An object that is the same height as they are
- ♦ An object that is shorter than they are
- ♦ An object that is taller than they are

### Where's the Measurement?

Home visitors can bring print-outs of the Infant/Toddler and/or Preschool *Where's the measurement?* photomontages<sup>\*</sup> to a home visit. Children will enjoy looking at and talking about the photos. And the parent and home visitor can discuss the types of measurement that children are learning about in the pictures.



<sup>\*</sup>Full-size Math Bingo and Measurement photomontage handouts are available at the end of this chapter.



## Notes



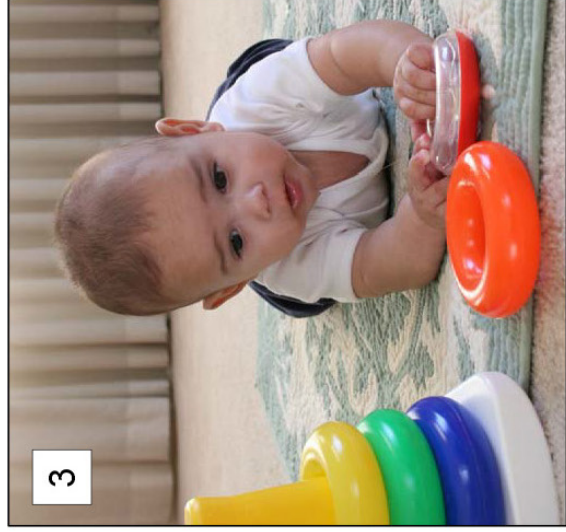


## Self-Assessment for Early Head Start Staff Measurement

<b>Skills for Adults Working with Children Birth-3 Years of Age</b>	<b>I am not skilled in this area</b>	<b>I am somewhat skilled in this area</b>	<b>I am highly skilled in this area</b>		
I know measurement-related content and terminology in the program’s infant and toddler curricula and assessment tools.	1	2	3	4	5
I understand what to expect infants and toddlers to know and be able to do related to measurement and comparing.	1	2	3	4	5
I write and use teaching plans that engage babies and toddlers in multi-sensory measurement-related experiences.	1	2	3	4	5
I provide a variety of materials, manipulatives, objects, and toys that support learning about size, weight, length, and other measurement concepts.	1	2	3	4	5
I know about and have access to a variety of resources to support children’s developing knowledge and skills related to measurement.	1	2	3	4	5
I recognize or find the measurement in infants’ and toddlers’ daily routines and interactions.	1	2	3	4	5
I provide families with information, activities, and measurement experiences to do at home.	1	2	3	4	5

# Where's the measurement?

Discuss measurement concepts and vocabulary related to what these infants and toddlers are doing.



**Mathematize** means to bring out, or highlight, the math concepts during an interaction with a child or group of children. Adults can mathematize a child's experience by:

- using math language
- emphasizing the math concepts
- posing math questions or problems to solve
- providing engaging materials and opportunities that support mathematical thinking



## Self-Assessment for Head Start Staff Measurement

<b>Skills for Adults Working with Children 3-5 years of age</b>	<b>I am not skilled in this area</b>	<b>2</b>	<b>I am somewhat skilled in this area</b>	<b>4</b>	<b>I am highly skilled in this area</b>
I know the key indicators related to Measurement.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I understand what to expect preschool children to know and be able to do related to measurement and comparing.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I write and use teaching plans that engage preschoolers in developmentally appropriate measurement experiences.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I can mathematize or find the measurement in children's daily routines and interactions.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I can recognize and describe different strategies that children use to compare height, area, weight, volume, etc.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I understand the difference between non-standard and standard measurement.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I provide families with information, activities, and measurement experiences to do at home.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I know about and have access to a variety of resources about children's developing knowledge and skills related to measurement.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>



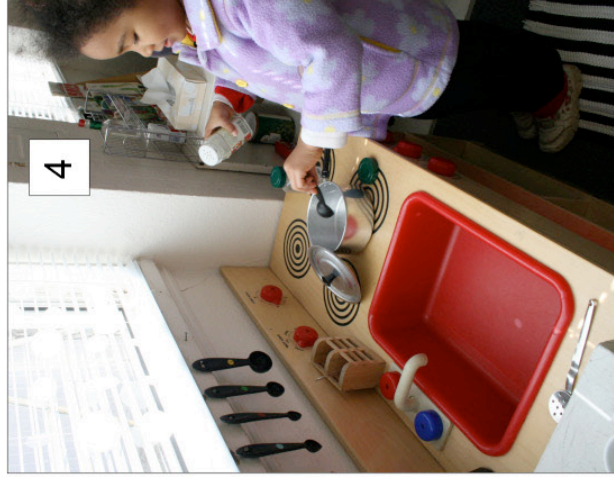
# Where's the measurement?

Discuss measurement concepts and vocabulary related to what these preschoolers are doing.



**Mathematize** means to bring out, or highlight, the math concepts during an interaction with a child or group of children. Adults can mathematize a child's experience by:

- using math language
- emphasizing the math concepts
- posing math questions or problems to solve
- providing engaging materials and opportunities that support mathematical thinking





## Everyday Math BINGO

Move around the room and collect one signature for each box from a person who...

1. Enjoys drawing or painting	2. Is good at judging distances when driving	3. Can choose the line at the grocery store that will take the least time to get through	4. Can tell you some feature his/her vehicle <i>doesn't</i> have
5. Is good at card games, like Blackjack (21)	6. Puts dishes or tools away in a particular way	7. Knits or beads	8. Can count to 20 in two languages
9. Can count to 20 in <i>more</i> than two languages	10. Can double or halve a recipe	11. Is good at putting together “assemble it yourself” furniture	12. Makes quilts
13. Knows height in English <i>and</i> Metric system	14. Can navigate through an unfamiliar place using a map	15. Likes doing Sudoku number puzzles	16. Knows what phase the moon is in



## Self-Assessment for Home-Based Staff Measurement

<b>Skills for Adults Working with Parents and Children in Home-Based Program Options</b>	<b>I am not skilled in this area</b>	<b>2</b>	<b>I am somewhat skilled in this area</b>	<b>4</b>	<b>I am highly skilled in this area</b>
I know the key Measurement indicators.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I understand what children should know and be able to do at this age related to measurement and comparing.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I help parents and guardians feel comfortable and confident in their ability to mathematize or talk about simple measurement ideas.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I model how to find the measurement in families' daily routines and interactions and environments.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I develop and/or use teaching practices that engage children and families in multi-sensory, measurement experiences.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I provide families with information, activities, and measurement experiences to do with their children.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I point-out and discuss safe measurement tools and materials families already have in their home.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>





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## Notes





## Appendix





**SOLAR** *Strengthening Operations for Learning And Results*

# Infant/Toddler Classroom Staff Skill Profile

<b>Name</b> _____	<b>Supervisor's Name</b> _____	<b>Reviewers' Initials</b> _____
<b>Select</b> <input type="checkbox"/> <b>Head Start</b> <input type="checkbox"/> <b>Early Head Start</b> <input type="checkbox"/> <b>Other</b> <b>Center</b> _____		
<b>Position</b> <input type="checkbox"/> Lead Teacher <input type="checkbox"/> Head Teacher <input type="checkbox"/> Teacher <input type="checkbox"/> Teacher Aide <input type="checkbox"/> Teacher Assistant <input type="checkbox"/> Family Child Care Provider <input type="checkbox"/> Mentor Teacher <input type="checkbox"/> Mentor Coach <input type="checkbox"/> Other: _____		
<b>Highest Level of Education Achieved</b> <input type="checkbox"/> High School/GED <input type="checkbox"/> Pre-degree Certificate <input type="checkbox"/> Associate Degree <input type="checkbox"/> Child Development Associate <input type="checkbox"/> Baccalaureate Degree <input type="checkbox"/> Graduate Degree <input type="checkbox"/> Other: _____		
<b>Years in Program</b> <input type="checkbox"/> 0–1 Year <input type="checkbox"/> 2–5 Years <input type="checkbox"/> 6–10 Years <input type="checkbox"/> 11–15 Years <input type="checkbox"/> 16+ Years		
<b>Years of Experience in Content Area</b> <input type="checkbox"/> 0–1 Year <input type="checkbox"/> 2–5 Years <input type="checkbox"/> 6–10 Years <input type="checkbox"/> 11–15 Years <input type="checkbox"/> 16+ Years		

<b>SKILL INDICATORS</b>		LIMITED	ADEQUATE	STRONG	EXEMPLARY	N/A
<b>1. Effective Teaching Practice</b>						
1.1	Sets learning goals and plans learning experiences by integrating knowledge of each child’s temperament, interests, gender, culture, language, learning approaches, understanding, misconceptions, and abilities and by working collaboratively with families and a range of specialists (e.g., medical, dental, speech, nutrition, mental health)	□	□	□	□	□
1.2	Demonstrates respect for families’ values, strengths, and cultures by welcoming their contributions and participation, encouraging children to talk about their families, and designing learning experiences accordingly	□	□	□	□	□
1.3	Uses information about children obtained through home visits, parent-teacher conferences, and other parent-staff interactions by incorporating this data into daily routines and interactions with children	□	□	□	□	□
1.4	Supports children’s overall development by integrating sensory learning experiences related to all domains throughout the curriculum, environment, and day	□	□	□	□	□



Project SOLAR was developed by Education Development Center, Inc. under the Innovation and Improvement Project grant #90YD0205 from the Office of Head Start, Administration for Children and Families, U.S. Department of Health and Human Services.



SKILL INDICATORS		LIMITED	ADEQUATE	STRONG	EXEMPLARY	N/A
1.5	Promotes children's security and attachment by responding promptly and consistently to their needs, providing frequent and affectionate one-on-one contact, and offering predictable daily routines and interactions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.6	Enables children to develop emerging skills and practice existing ones by engaging them in individual and small-group experiences designed to enhance their development and learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.7	Promotes children's development of fine- and gross-motor skills by providing a variety of materials (e.g., puzzles, stacking toys, balls, climbing structures), equipment, and opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.8	Fosters children's curiosity, engagement, reasoning, and problem solving by providing a balance of open-ended exploration, teacher-guided inquiry, structured activities, and sensory-based play	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.9	Helps children acquire meaningful content knowledge by ensuring that learning experiences and routines are child-centered and are based on information that is current, accurate, and focused at the children's level of understanding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.10	Helps children gain independence and autonomy in eating, toileting, dressing, and hygiene by encouraging presenting age-appropriate and manageable tasks and by recognizing their accomplishments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.11	Builds children's awareness of and ability to follow basic health and safety rules by providing opportunities for health and safety learning (e.g., implementing and discussing routines—washing hands, fire drills, crossing streets) and by supervising children at all times and positively redirecting them from potentially harmful activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.12	Supports families in extending children's learning at home by providing newsletters, take-home activities, home visits, and parent-teacher conferences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.13	Helps children who are learning English by providing them with the supports (e.g., props, gestures, incorporating basic words in the child's home language, securing volunteers who speak the child's language) they need to fully participate in classroom experiences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.14	Helps children expand their emergent language and literacy skills by cuing in and responding to children's non-verbal forms of communication (e.g., gestures, sounds)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>2. Content Area Domains</b>						
2.1	Fosters teacher-child and child-child communication intentionally by facilitating mutual sharing and authentic exchange of ideas, thoughts, and feelings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.2	Advances children's listening, understanding, and communicating skills and supports development of content knowledge by commenting on children's activities and experiences and describing children's actions and events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.3	Builds children's vocabulary by regularly introducing new and challenging words, discussing them, and infusing them into ongoing activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



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SKILL INDICATORS		LIMITED	ADEQUATE	STRONG	EXEMPLARY	N/A
2.4	Cultivates children's understanding of and appreciation for books by gathering a wide range of high-quality children's literature, including board books, for children to explore on their own or with a teacher	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.5	Enhances children's knowledge and language and literacy development by regularly reading books with children individually, in small groups, and in various settings (e.g., block area, housekeeping area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.6	Furthers children's listening, vocabulary, and attention span through book reading by using prompts for discussion and follow-up activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.7	Encourages children's scribbling and other emergent writing skills, their awareness of print, and the varied purposes for writing by providing and using a range of writing materials (e.g., markers, crayons, finger paint, letter magnets) and environmental print (e.g., traffic signs, labels in the classroom, store signs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.8	Supports children's interest in and awareness of numbers, counting, and problem solving by initiating counting games and activities and by providing materials that link number concepts to numerals and mathematical understanding and vocabulary	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.9	Promotes children's understanding of size, shape, color, and directionality by engaging them in small- and large-motor activities that require them to sort, match, identify patterns, group objects, and measure objects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.10	Builds children's ability to compare and talk about the similarities and differences between objects by providing experiences with sorting, matching, patterns, grouping, and measurement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.11	Assists children in understanding math and science concepts by embedding math and science experiences into everyday routines, music, movement, literacy, art, and play	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.12	Helps children expand their knowledge of their bodies and the world around them by planning and implementing age-appropriate activities and explorations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.13	Encourages children's use of scientific inquiry by offering experiences and opportunities to explore and investigate their immediate environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.14	Expands children's knowledge of nature, living things, and materials and processes by providing objects, tools, and experiences that enable them to closely observe and explore nature and scientific concepts (e.g., cause and effect, time, temperature, buoyancy, changes in materials)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.15	Facilitates children's ability to listen to, interact with, and appreciate different types of music by providing individual and group experiences with singing, finger plays, creative movement, and musical instruments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.16	Develops children's imagination and creativity by providing child-directed and teacher-guided opportunities for them to express their thoughts, ideas, experiences, and feelings through various media (e.g., movement, dance, drama, music, visual arts)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



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SKILL INDICATORS		LIMITED	ADEQUATE	STRONG	EXEMPLARY	N/A
2.17	Helps children learn about themselves and others by designing and implementing meaningful experiences to explore similarities and differences between people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.18	Facilitates children's learning about their community by using play, language and literacy experiences (e.g., conversations, books, writing), and face-to-face interactions (e.g., field trips) that reflect children's familial and cultural backgrounds and illustrate the roles and interconnectedness of community members	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.19	Builds children's understanding of their own and other cultures by providing opportunities for them to learn about the culture and traditions, linguistic diversity, and family structures of the children and families within their classroom and the greater community	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.20	Fosters children's social and emotional development by providing warmth, sensitivity, nurturance, acceptance, and safety and by encouraging them to express and understand their feelings and emotions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.21	Promotes children's development of age-appropriate, self-regulated behaviors by using routines, schedules, and classroom design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.22	Supports children's decision making and autonomy by encouraging them to initiate activities of their own choice and by modeling conflicts independently and by modeling ways to share, help, and cooperate with others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.23	Encourages children to work collaboratively by fostering group learning, joint problem solving, and reasoning opportunities through teacher-initiated activities and play	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>3. Learning Environments</b>						
3.1	Promotes children's active exploration, creativity, and development in all domains by designing indoor and outdoor environments based on knowledge of how children develop and learn, and their individual abilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2	Ensures that children are intellectually challenged by selecting, organizing, and using high-quality materials and equipment and by adapting the environment to support each child's skill acquisition and success	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3	Maintains a healthy physical environment by following health and safety procedures (e.g., following universal precautions, regularly sanitizing equipment, child-proofing environments)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4	Supports the goals of the curriculum by planning and establishing distinct and child-accessible learning centers and changing materials intentionally	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.5	Extends the learning environment beyond the classroom by accessing the community (e.g., fire station, library, construction site)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.6	Builds children's pride in their cultures, families, and communities by ensuring that classroom learning centers and materials reflect children's cultures and communities (e.g., books and print in families' languages, family photographs, items from their culture)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



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SKILL INDICATORS		LIMITED	ADEQUATE	STRONG	EXEMPLARY	N/A
<b>4. Observation, Analysis, Planning, and Documentation</b>						
4.1	Meets federal, state, and program documentation requirements by maintaining accurate, objective, complete, timely, and well-organized child and family records	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.2	Monitors children's progress per the goals developed by self and other staff and specialists, including those in IFSPs, by observing and documenting children's play, conversations, routines/schedules, and work samples and through conversations with families	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3	Plans individualized experiences and small- and large-group activities by using child observation, screening, and assessment data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4	Identifies children who need referrals by reviewing child observation, screening, and assessment data in collaboration with the classroom team, specialists, and families	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.5	Broadens ability to accurately assess children's development by seeking consultation to supplement own observation and planning and to determine when referral is needed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.6	Aligns goals and approaches to support children's progress by engaging with program staff, specialists, families, and staff in other learning settings who also serve the child	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.7	Offers families opportunities to increase their child observation skills by providing written and verbal information and encouraging participation in classroom and family education activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.8	Facilitates transitions to or from Early Head Start, Head Start, home, and/or other early education and care settings by engaging families, others in the program, and members of the community in planning and implementing strategies that ensure successful transitions, including the transfer of child records	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.9	Contributes to program's reports to local, state, and federal officials and funders by providing accurate data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>5. Communication</b>						
5.1	Demonstrates respect for others by sharing information objectively and non-judgmentally and adjusting verbal and written communication strategies for different audiences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.2	Fosters partnerships with families by using conversational interviewing strategies, minimizing the use of interview checklists, respecting and encouraging the decision-making role of families, and engaging them in goal setting and discussions about their concerns	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.3	Ensures that own communication is easily understood by speaking and writing clearly and using standard grammar and spelling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.4	Facilitates communication with others by using available technologies (e.g., fax, voice-mail, computers—e-mail, file sharing)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



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SKILL INDICATORS		LIMITED	ADEQUATE	STRONG	EXEMPLARY	N/A
5.5	Employs a culturally competent and flexible approach when working with those from various cultures by acknowledging, accepting, and accommodating differences (e.g., providing information in an understandable format and/or language for those who have limited/no reading skills or who are English language learners)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.6	Builds an understanding of the program by communicating its philosophy, mission, and services to staff, families, and the community	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.7	Promotes a unified approach to sharing child information with families by engaging in joint planning with other classroom staff and specialists to prepare for home visits and other family contacts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>6. Professionalism/Leadership</b>						
6.1	Establishes and maintains external professional relationships by participating as a member of community, state, and/or national professional organizations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.2	Exhibits an understanding of early learning standards and guidelines by incorporating them into own teaching practice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.3	Links current research on and best practice in education, family, health and/or disabilities services to own work by keeping abreast of new information and reflecting on its relevance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.4	Furtheres professional growth by seeking feedback, reflecting on and assessing own practice, and taking advantage of opportunities to improve skills and knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.5	Promotes a collaborative, productive working environment by sharing planning, decision making, and problem-solving responsibilities with other classroom staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.6	Advances program practice by working collaboratively with other staff to understand and support the adoption of best practices for children, families, and staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.7	Serves as a role model for families and other staff by following and exhibiting sound, daily physical and emotional practices (e.g., wearing seat belts, making healthful food choices, washing hands, communicating positively, understanding and accepting cultural differences)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.8	Supports program improvement efforts by contributing information to the program's planning, evaluation, self-assessment, and other program development efforts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.9	Maintains professional boundaries in relationships with staff and families by distinguishing between others' needs and one's own, guarding against abuse of power and sexual misconduct, and using appropriate language	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.10	Ensures family confidentiality by limiting conversations about families and access to their records to those directly involved in providing services to them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>7. Other Program/Organizational Priorities</b>						
7.1		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



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SKILL INDICATORS		LIMITED	ADEQUATE	STRONG	EXEMPLARY	N/A
7.2		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.3		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.4		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.5		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.6		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.7		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.8		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.9		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.10		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.11		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.12		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.13		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.14		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.15		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.16		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.17		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



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SKILL INDICATORS		LIMITED	ADEQUATE	STRONG	EXEMPLARY	N/A
7.18		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.19		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.20		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>





## Math Scan Part 1: Inventory of Materials & Equipment

### Directions:

Part 1 is designed to help you determine the potential of materials and equipment available in the learning environment to address the mathematical learning of young children. Materials and equipment that can support early math concepts may be located in a variety of areas. Such equipment and materials offer the potential for teaching teams to “mathematize” children’s learning experiences.

Check the box labeled *Observed* if you can answer “YES” to the question. If you did not see sufficient evidence to let you answer the question, then mark the box labeled *Not Observed*. You may document details of your observations of the set-up of the learning environment (or outside playground areas), specific materials, daily schedule, labeled areas of the environment, etc. that you determine to be math-related in the *NOTES*.

\*\*\*\*\*

Please provide the information below when you begin your observation:

Number of children present: \_\_\_\_\_

Number of adults present: \_\_\_\_\_

Beginning time of observation: \_\_\_\_\_

Ending time of observation: \_\_\_\_\_

Activities taking place (such as circle time, free play, lunch time): \_\_\_\_\_

How many times have you observed previously in this classroom using the math scan? \_\_\_\_\_

### Room Arrangement, Materials, Equipment

1. Do you see math materials available for children’s use? (Examples: measuring tools, scales, number lines, counting bears, unit blocks, pattern blocks, cash register, computers with children’s software)

Observed

Not observed

NOTES:

2. Do you see teacher-made, class-made, or commercially produced math-focused displays in the classroom environment? (Examples: a border of numerals around the perimeter, bulletin board displays, graphs, charts, or measurement of children’s height)

Observed

Not observed

NOTES:

3. Do you see numerals or other math-related products that are child-made and would suggest children's experiences with math concepts? (Examples: in children's individual work or on graphs, charts, stencils or cutouts of shapes that children have made)

- Observed
- Not observed

NOTES:

4. Do you see counting books? (Examples: *Anno's Counting Book*, *Mouse Count* – some books with just numerals or some that include words or a narrative that uses numerals, like *Three Little Pigs*)

- Observed
- Not observed
- NOTES:

5. Do you see children's books that emphasize other math concepts? (Examples: books about shapes, patterns, measurement, comparisons of — size or quantities)

- Observed
- Not observed

NOTES:

6. Do you see math-related books or other printed materials placed or located in different activity centers or learning areas in the classroom? (Examples: shape or construction books in the block center, recipes or menus in dramatic play)

- Observed
- Not observed

NOTES:

## Math Scan Part 2: Observation in the Learning Environment

### Directions:

Part 2 of the Math Scan is designed to help you organize and analyze what you observe during a 20-minute time period. Be sure you are familiar with the Child Outcomes Framework and in particular, the Domain Elements that address Mathematics and Approaches to Learning.

Take running records of each 20-minute observation period.

- Observe what children are doing in small groups, individually, and with the teacher(s).
- Observe the teaching team’s interactions with children.
- Observe children’s interactions with their peers.
- Consider how the teaching strategies and interactions you observe offer clues to the mathematical understanding and problem-solving abilities of teaching teams and young children.

You might want to allocate your observation time in segments. For example, a 20-minute observation period could be allocated in the following way:

Teacher	5 minutes
Teaching Assistant	5 minutes
Child #1	4 to 5 minutes
Child #2	4 to 5 minutes

### What Math Vocabulary and Concepts Do Teaching Teams Use?

Complete the following table. For each math domain element you observe, determine whether it is *planned* or *spontaneous*, using these guidelines:

*Planned* — an activity or interaction with a child (ren) seems planned or intentional on the teacher’s part. Often the presence of teacher-prepared materials indicates a planned activity; or you may see a time on the schedule for teacher-directed activities to occur with a math focus. *Spontaneous* — an activity or interaction with child (ren) that seems unplanned and “of the moment.” For example, a math-related conversation during meal time, or a suggestion that measurement tools be used to answer a question about “how much”.

Then note some details of your observation in the space provided.

Domain Elements (from the Head Start Child Outcomes Framework)	Observation Notes
Numbers (Counting)	___ Planned
	___ Spontaneous
Operations (Computation, e.g., How many are left?)	___ Planned
	___ Spontaneous
Geometry (Shapes)	___ Planned
	___ Spontaneous
Spatial Sense (Directionality)	___ Planned
	___ Spontaneous
Patterns (Similarities & Differences)	___ Planned
	___ Spontaneous
Measurement (Quantities & Sizes)	___ Planned
	___ Spontaneous

1. Do you see math integrated with other Domains from the *Head Start Child Outcomes Framework*? For example:

- children in the dramatic play area pretend to set up a grocery store with labels with the price of food or a cash register;
- children create an art project includes shapes – Creative Arts;
- children use measuring cups to mix paint in primary colors into secondary colors with the teacher noting that different size measuring cups can hold different amounts of paint — Art and Science; or
- children are jumping rope while a teacher claps and sings a rhyme, or counts aloud while -- Physical Health & Development

- Observed  
 Not observed

NOTES:

2. Do you see the teaching teams informally assessing children’s current understanding of mathematical concepts? For example:

- teaching staff probe to gauge what knowledge children have about a particular math concept -- a child is stringing beads and the teacher challenges him/her to recognize or make a pattern that varies by color or by shape; or
- teaching staff ask probing questions when a small group is discussing who is taller and how to find out

- Observed  
 Not observed

NOTES:

3. Do you see a math focus reflected in instruction or activities and/or is there a time set aside in the daily schedule for math?

Observed (check all that apply)

- Circle time  
 Individual child instruction  
 Small group  
 Large group

- Not observed

NOTES:



4. Do you see the teaching team encouraging children to use math concepts? For example:

- routine counting activities;
- lining up by your favorite number;
- counting off by 2s;
- identifying patterns in clothing;
- asking questions like, “which block is longer?”;
- suggesting a child use a ruler to measure; and
- asking open-ended questions to help scaffold children’s problem-solving abilities

- Observed  
 Not observed

NOTES:

5. Do you see the teaching teams promoting children’s math learning with concrete, direct experiences with manipulative materials?

- Observed  
 Not observed

NOTES:

## Math Scan Part 3: Guided Discussion

There are several ways Part 3 could be used. These include:

- (1) as an initial baseline measurement of where teaching staff think their knowledge base and functional skills are (perhaps after the “Where’s the Math?” activity or a review of the Math Domain and Domain Elements from the Head Start Child Outcomes Framework);
- (2) when time permits, the learning environment observations captured in Math Scan Part 2 may be complemented by a follow-up discussion with teaching team members, either together or individually; and/or
- (3) with a focus group including a number of teachers from different classrooms or centers.  
These opportunities for discussion may inform you about:
  - items or topics that you didn’t have an opportunity to observe;
  - items or topics that you observed and want to clarify; and
  - the teacher’s priorities for professional development in early childhood math.

**Suggested areas of discussion/inquiry for your group or individual meetings:**

Can you say more about math-related aspects of your classroom?

- Room Arrangement, Materials, Equipment
- Math Learning Experiences
- Teacher Behaviors

Can you say more about professional development?

- What skills or knowledge about math could you share with other staff?
- What are your priorities for helping children learn about math?
- What kind of professional development opportunities have you had related to math?
- What do you think would help you promote children’s math learning and outcomes?

## OHS Environmental Math Scan Data Analysis Tool

**Date:**

<b>Mathematics Domain Element (check one)</b> <input type="checkbox"/> Pattern <input type="checkbox"/> Geo/SS <input type="checkbox"/> Numb/Ops <input type="checkbox"/> Measurement	Are there appropriate <b>planned</b> experiences and conversations to support this math Domain Element?	Are there appropriate <b>spontaneous</b> experiences and conversations to support this math Domain Element?	Do lesson plans, materials, and room arrangement show evidence of thoughtful experiences and individualization related to this Domain Element?	Review the math outcomes data reports. Are the preschool child outcomes positive? Where are the strengths and weaknesses?	Next Steps: Professional Development Planning  What kind of support, materials, resources, or training will best meet the individual and collective needs of the teaching staff?
Site:  Classroom:  Teachers:					
Site:  Classroom:  Teachers:					

Use this tool to summarize data from the OHS Math Scans conducted in each classroom. Copy as many as needed. Look at all the data together to write a response to the Next Steps questions in the last column.

# *Curriculum Overview*

## *Steps to Success: Early Literacy Mentor Coaching*

### Unit 1: Building Relationships to Enhance Child Literacy Outcomes (Blue)

#### **Mentor-coaching Processes**

- Establish trust through communication and support
- Clarify roles and expectations
- Use culturally sensitive practices
- Appreciate different learning styles and how adults learn
- Understanding the process of change

#### **Literacy Content**

Book Knowledge and Appreciation  
Print Awareness and Concepts

### Unit 2 – Observation and Analysis (Tan)

#### **Mentor-coaching Processes**

- Conduct objective observations
- Assess the quality of language and literacy practices
- Examine classroom observation tools
- Reflect on observation techniques to improve practices
- Interpret data from formal observations

#### **Literacy Content**

Early Writing  
Alphabet Knowledge

### Unit 3: Reflective Practice (Green)

#### **Mentor-coaching Processes**

- Plan, conduct and analyze reflective conferences
- Use dialogue journals and peer feedback journals

#### **Literacy Content**

Oral Language Development

### Unit 4: Using Child Assessment Information to Guide Instruction (Purple)

#### **Mentor-coaching Processes**

- Assessment for instructional planning
- Developmentally appropriate assessment
- Addressing observer bias
- Multiple strategies for collecting assessment data
- Sharing assessment results
- Video taping to analyze children’s learning

#### **Literacy Content**

Phonological Awareness

For more information about Mentor-Coaching or the *Steps to Success* mentor-coaching curriculum visit the Early Childhood Learning and Knowledge Center website at <http://eclkc.ohs.acf.hhs.gov/hslc/resources/cinema/STS/testingsts.htm>

## Finding the Math in Books: Ideas for Staff Introduction

Children’s books help open the world to young children. Books offer staff a powerful tool for expanding young children’s mathematical vocabulary and supporting their developing mathematical knowledge.

Through book reading, children can have mathematical experiences during a familiar and engaging activity. As children and adults talk about the math concepts and relationships they find in the story or illustrations, children build their conceptual understanding and their math-related vocabulary. Problems found in books can stimulate children’s mathematical thinking.

Through book-reading experiences children can:

- practice their developing mathematical skills
- develop their abilities to reason about mathematical situations
- solve problems
- express their thinking through their actions and words
- increase their natural interest in math

Sharing books with children is a way for staff to learn more about what children know and understand about math and to expand children’s understanding of math. This guide provides information on how to use books to highlight math learning. Staff may also want to share this information with the families of the children in their classroom.

Children often reveal what they know about math as they interact with books. For example, children will often spontaneously count objects in a book or make comments about the size or position of characters in a book (“That dog is so big!”). Children’s questions and their responses to adults’ comments let us know (1) what they know and (2) what they are thinking.

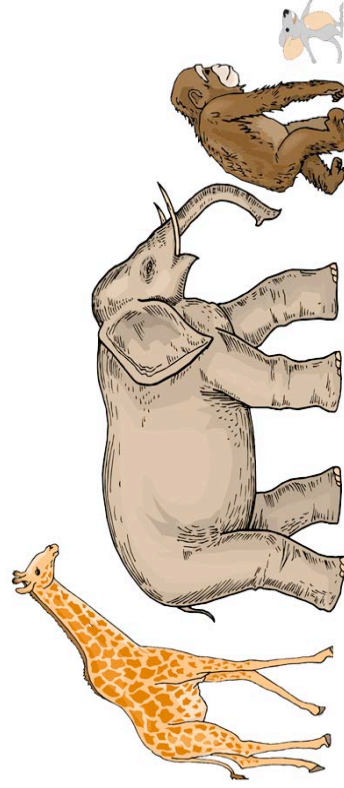


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Staff can use books, with individual children or small groups, to assess children's mathematical understanding and help them to solidify and expand their knowledge and their vocabulary.

Many children's books are rich in math and math-related content. Some children's books focus specifically on math concepts. These range from simple counting books to books that embed math concepts or problem solving in the story or pictures.

Others, including many favorites, are not specifically mathematical but include situations in their text or illustrations that invite "mathematizing." Such books allow staff to intentionally expand children's understandings and their vocabularies.



For example, *Good Night Gorilla* is a story about a zookeeper saying good night to each of the animals in the zoo. While this is not specifically a number book, staff can encourage children to count the animals, to talk about the sequence of events in the story ("Who did the gorilla let out last?"), and to learn ordinal number words (first, second, third).

## Finding the Math in Books: Ideas for Staff Introduction

How can staff “mathematize” book reading? It is helpful for staff to read the book to themselves before reading it to children. This enables them to identify vocabulary words and concepts that they want to focus on to expand children’s knowledge.



Staff can enhance the book-reading experience in these ways:

- Use a variety of mathematical vocabulary to describe pictures or events in the book. For example, use math language to talk about the scenes in Goodnight Moon – “The **two** little kittens are in the **middle** of the rug.”
- Draw children’s attention to mathematical relationships, such as same, more than, less than.
- Encourage children to solve problems posed in the story line.
- Pose natural mathematical questions that follow from the text or illustrations of the book. For example, books like *Is It Larger? Is It Smaller?* picture many objects that children will enjoy counting. Ask “How many hats are hanging on the wall?”
- Use children’s natural interests to introduce new math concepts. For example, use a child’s interest in animals to talk about the number of animals on each page.
- Carry the mathematical concepts and language from a book-reading experience to daily experiences. For example, after reading *The Carrot Seed*, plant seeds and keep a record of how long it takes for the seeds to come up.

## Finding the Math in Books: Ideas for Staff Introduction

- Consider the cultural and linguistic characteristics of individual families when selecting books. People enjoy and are comfortable with different things. Choose a variety of books, including books that reflect the cultural heritage and languages of families in your program. Give lots of options!



## Glossary of Math Terms

**Addition:** A mathematical operation in which two or more numbers are summed to yield a single number (the total).

**Attribute:** A property or characteristic. In geometry, this refers to shape attributes. For example, attributes of triangles include three sides and three angles or corners. In measurement, attribute refers to a measurable dimension such as length, weight, or temperature.

**Cardinal number (Cardinality):** The number that describes the total quantity of objects (or other elements) in a group. In counting a group of objects, the cardinal number is the last number spoken. This number answers the question “how many?”

**Comparing and ordering (in measurement):** Process of comparing two or more objects by attributes such as length, weight, area, or capacity to determine which is longer or shorter, heavier or lighter, covers more or covers less, or holds more or holds less. See **Direct comparison**.

**Comparing and ordering numbers:** The process of determining which of two groups of objects has more or if they are the same, or determining which of two numbers is greater than the other (e.g., 6 is greater than 5). Understanding the relationship (more than, fewer/less than, same as or equal to) between quantities of objects or spoken numbers is an important aspect of young children’s developing number sense.

**Composing and decomposing numbers:** Discovering the many ways that a number can be put together (composed) and taken apart (decomposed). For example, 5 objects can be decomposed to make a group of 2 objects and a group of 3 objects (or 4 and 1).

**Composing and decomposing shapes:** Discovering the ways that shapes can be combined or divided to make other shapes. For example, two congruent right triangles can be put together to compose a square. A square can be decomposed into two triangles by drawing a line diagonally from corner to corner.

**Concrete object:** A visible, touchable thing.

**Continuous quantity:** An amount that is **not** made up of discrete, countable items. We measure continuous quantities like length, weight, or time by applying countable units like inches, pounds, or minutes.

**Dimension:** A measurable attribute such as length, width, depth, or height.

**Direct comparison:** A measurement strategy for comparing the length, area, weight, or capacity of two or more objects. For example, two pencils can be directly compared to determine which one is longer by placing them side by side with the ends aligned.

**Discrete quantity:** Refers to an amount that is made up of individual, countable items such as blocks, drumbeats, or words.

**Division:** A mathematical operation that involves grouping or sharing a quantity into equal parts. The quantity that remains (if any) after equal groups are made is called the remainder. Children practice early division skills when they share snack or toy items fairly with their classmates.

**Geometric shapes:** Two- and three-dimensional shapes whose attributes, such as number of sides, number of angles, and number of dimensions, are described and studied in geometry. There are many examples, including triangles, circles, squares, prisms, spheres, and cubes.

**Geometry:** The area of mathematics that concerns space and shape.

**Growing pattern:** A pattern in which there is a predictable change in number or size. An example is the “plus one” pattern in which each unit in the sequence has one more element than the one preceding it (e.g., A, AA, AAA, AAAA).

**Learning environment:** Any setting or situation in which a child might be learning—during play, daily routines, planned experiences, and social interactions at home, school, or in the community. A mathematics learning environment is any setting or situation in which a child might be learning math.

**Manipulatives:** Concrete objects used to support math learning. For example, counting bears are manipulatives that can be used for practicing counting, sorting by color and size, duplicating and creating patterns, simple addition and subtraction with objects, and for supporting many other mathematical concepts and skills.

**Mathematize:** To highlight mathematical concepts in everyday experiences.

**Multiplication:** A mathematical operation in which a quantity is added to itself a certain number of times. For example, 3 times 2 ( $3 \times 2$ ) is three 2s added together ( $2 + 2 + 2$ ).

**Non-standard measurement:** Measuring that does **not** involve a standardized unit (inch, pound, etc.). For example, children might measure their heights using non-standard units such as blocks, or they might use lengths of string to measure and compare the size of two pumpkins.

**Non-standard measurement tool:** Any item used as a non-standard unit for measuring. See **Non-standard measurement**.

**Number:** Describes a countable quantity.

**Number word:** Spoken, written, or signed word that represents a quantity, such as “one,” “two,” or “three.”

**Numeral:** A written symbol that represents a number, such as 1, 2, or 3.

**One-to-one correspondence:** Matching one object, word, or action to another object, word, or action (one for one). In counting objects, one-to-one correspondence refers to matching one and only one number word to each item being counted.

**Operations:** Addition, subtraction, multiplication, and division of numbers.

**Ordinal number:** A number word that describes the order of objects, for example, “first,” “second,” or “third.”

**Part-whole relations:** The relationship between a whole number and its parts (the smaller numbers that compose it). See **Composing and decomposing numbers**.



**Pattern:** A regular, predictable arrangement of things. Objects, numbers, sounds, actions, or events can make a pattern. (See **Repeating pattern** and **Growing pattern**.)

**Repeating pattern:** A pattern in which a sequence of elements (see **core unit**) is repeated again and again without change, such as “red stripe-white stripe, red stripe-white stripe, red stripe-white stripe.”

**Representing number:** Showing numerical information using concrete objects such as blocks, dice, and fingers; spoken number words such as “four”; or written symbols such as a numeral (4) or tally marks (/ / / /).

**Sequencing:** Arranging a set of items in order, according to a rule. For example, stones or other collected objects can be put in order from smallest to largest or largest to smallest. Numbers in the counting sequence are ordered by increasing value.

**Spatial relations:** The direction, position, order, or orientation of objects in relation to other objects. See **Spatial reasoning**.

**Spatial reasoning (spatial thinking; spatial sense):** Thinking about how objects fit together and can be moved in space, as well as how one’s body fits and moves in relation to objects in the environment. Spatial concepts include directionality, position, order, and location of people and objects in space and the words that describe these concepts.

**Standard measurement:** Measuring with standardized or standard units such as inches, pounds, or degrees using tools like rulers, scales, and thermometers.

**Standard measurement tool:** A device that is used to apply standardized units to an attribute. For example, a ruler is used to measure the length of an object in inches or a scale is used to measure a person’s weight in pounds. See **Standard measurement**.

**Subitizing:** Identifying the number in a very small group of objects perceptually, by looking or touching, without needing to count.

**Subtraction:** A mathematical operation in which a quantity is removed or taken away from another. The resulting number is the difference between the starting number and the number taken away. For example, subtracting 2 from 5 leaves 3, which is the difference between 5 and 2.

**Symmetry:** An object is symmetrical when dividing it in half produces two parts that are mirror images of each other.

**Three-dimensional (3-D) shapes:** In geometry, shapes that have height, width, and depth dimensions. 3-D shapes can be measured with units of volume like cubic inches. Examples include spheres, cubes, and prisms. More information about 3-D shapes is provided in the handout, “Two- and Three-Dimensional Shapes, Attributes, and Properties.”

**Two-dimensional (2-D) shapes:** In geometry, shapes that have length and width dimensions, but no depth. 2-D shapes can be measured with units of area like square inches. Examples include triangles, circles, squares, and parallelograms. More information about 2-D shapes is provided in the handout, “Two- and Three-Dimensional Shapes, Attributes, and Properties.”