

STEAM

Thinking STEAM



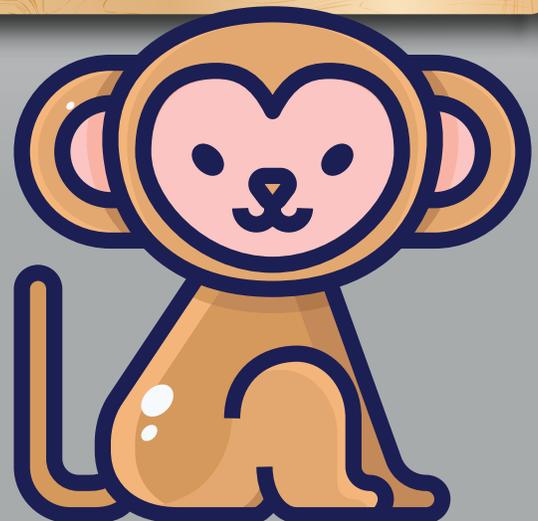
Teacher Time

Use with Teacher Time Webinars

This booklet includes resources to help education staff support children's thinking skills. Resources include strategies for making learning meaningful by supporting children's mathematical and science thinking as well as engaging children in the scientific method to help them observe, questions, make predictions, experiment, and more.



Teacher Time



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RESEARCH NOTES

LITTLE SCIENTISTS:

BUILDING EARLY STEAM SKILLS

STEAM learning is based on making observations, asking questions, making predictions, exploring, and reflecting. STEAM skills help us analyze information, think creatively, and solve problems. We use STEAM skills every day, from packing a car trunk to predicting how another person will react to a specific event.

THE TAKE HOME:

1. STEAM stands for Science, Technology, Engineering, Art, and Math. These topics are linked together because they rely on a common focus and approach.
2. STEAM is about asking questions and trying to figure out how things work.
3. Children naturally use STEAM skills to learn and explore their surroundings and make sense of the world.



WHAT DOES RESEARCH SAY?

- STEAM stands for Science, Technology, Engineering, Art, and Math. These topics are linked together because they rely on a common focus and approach. They all require gathering and using evidence to gain knowledge, create new things, and solve problems. **STEAM is about asking questions and trying to figure out how things work**, not about what facts you know.
- Infants and young children naturally use these STEAM skills to explore and learn about the world through play. Children act like scientists - they make observations and run experiments to see what will happen. In fact, more than half of children's natural playtime is spent playing a science or math-related activity.
- Research indicates that early STEAM skills provide a strong base for school readiness.



WHAT DOES IT LOOK LIKE?

- Children learn by exploring on their own, but they also depend on adults to guide their learning.
- You can help children enjoy STEAM by doing STEAM activities together. Early skills like creative thinking and problem solving establish the foundation for later learning and build confidence in STEAM areas.
- You don't need to know a lot about science or have special equipment to teach children about STEAM. Pay attention to what children are interested in—this is a great place to start! For example, a child might notice that his shirt got wet while he was washing his hands, and it feels heavier. Encourage the child to explore what types of things absorb water. Does a sponge or a block get heavier when you put it in water? Which one makes a better print on a piece of paper? Help parents practice asking open-ended questions like “Why might that be?” or “What else could we try?” Remember, STEAM is about asking questions and trying to figure out how things work – not which facts you know!
- Children naturally act like scientists. For example, an infant may predict that if she drops a toy, it will fall to the ground. She might then experiment with dropping different objects from different heights. Or, a child might explore different ways he can move his body patterns as he dances to music. He might try jumping to the beat of the music or moving his arms and legs in a coordinated way. Help parents recognize the observations, questions, and experiments their child does and think of ways to encourage their experiments and thinking.

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TRY THIS!

- Help children observe by asking, “What do you see?” Support curiosity by asking, “What do you want to know?” Extend children’s learning by saying, “What do you think will happen?” Support exploration by asking, “What should we try?” Help children reflect by asking, “What did you notice?” Encourage parents to notice and engage with what their children are exploring. Reflect on the kinds of STEAM play you observe in children and think about ways you can model STEAM skills in your interactions with families.
- Explore the outdoors and nature. You don’t need special equipment like microscopes to engage children in STEAM learning. Go outside or bring the outdoors inside! Nature is perfect for creative and active exploration and problem-solving. On home visits, help families find good spots to explore, whether it is the park down the street, or plants and trees around their home.
- Use materials that engage the senses. Explore with touch, smell, taste, sound, or sight. For example, bring different textured items on a home visit and have the child compare how objects feel. Observe which is rough, or squishy? After exploring, you might work together to create something new with the materials. This helps children use STEAM skills like making observations and creative thinking.

LEARN MORE:

NEWS YOU CAN USE: EARLY SCIENCE LEARNING FOR INFANTS AND TODDLERS

<https://eclkc.ohs.acf.hhs.gov/sites/default/files/pdf/nycu-early-science.pdf>

COACHING CORNER: FULL STEAM AHEAD: USING PRACTICE-BASED COACHING TO SUPPORT THE TEACHING OF SCIENCE

<https://eclkc.ohs.acf.hhs.gov/video/full-steam-ahead-using-practice-based-coaching-support-teaching-science>

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CONNECTING AT HOME

LITTLE SCIENTISTS:

BUILDING EARLY STEAM SKILLS

STEAM stands for Science, Technology, Engineering, Art, and Math. Children use STEAM skills all the time when they wonder, explore, solve problems, and communicate. STEAM learning is based on making observations, creating, asking questions, and exploring. STEAM is all around us, ready to be discovered by young explorers.

USE YOUR SENSES

Explore with touch, smell, taste, sound, or sight. For example, help your child compare how objects feel. Which is rough, soft, smooth, or squishy? Together you can make observations about how something feels. After exploring, create something new with the materials. These skills are important for STEAM learning.

EXPLORE TOGETHER

A key part of helping your child enjoy STEAM is to do STEAM activities together. Children learn from other people, and they enjoy learning with others. For example, consider ways to make music as a group. Working together makes activities more meaningful and fun!

ASK QUESTIONS

Ask questions to guide your child's learning. Listen to their response. For infants, watch for their responses. Then expand upon it. It's ok if you don't know all the answers! It's not about right or wrong. The important thing is that you and your child observe, question, predict, explore, and reflect together.

LOOK OUTDOORS

Looking for STEAM inspiration? Try exploring outdoors! For example, you could ask "Do you see any birds? Let's see if we can find more! Where else might we see birds?" You don't have to go far to explore nature. If you live in a city, you can count bugs on the sidewalk or talk about the direction of the wind. You can also bring the outdoors inside by collecting leaves in the park.



NEWS YOU CAN USE

News for Head Start, Early Head Start, & Migrant/Seasonal Programs

INSIDE:

Supporting Early Learning for Infants and Toddlers | Where is the Math?
| Components of Math | Engaging Families | Conclusion

SUPPORTING EARLY MATH LEARNING FOR INFANTS AND TODDLERS

Ervin holds Marshall, his six-month-old son, in his arms as he bottle feeds him during a home visit. Ervin shakes his head and says, "Marshall doesn't seem happy about drinking his bottle. He's drinking it slower than usual and he keeps playing with the nipple with his tongue. He was the same way this morning. He usually finishes his bottle pretty quickly!" Shelly, his home visitor, watches for a few moments, then asks, "Has something about his bottle feeding changed?" Ervin responds, "Not really. Feeding time, formula, and bottle are the same. Oh, but when I went to the store last night to buy new nipples, they didn't have the ones I usually get. So I got different ones. I put the new nipple on this morning. You don't really think he's noticing the different nipple, do you?" Shelly smiles and nods her head. She kneels on the floor in front of Marshall and says, "Marshall, I think we know why you're not happy. Your bottle has a new nipple! It's not the same as your old one. It has a different shape and it feels different in your mouth. You noticed something different about your bottle and you're letting us know you noticed!"



"Infants and toddlers begin to develop math concepts and skills in the first years of life."

Dani (11 months old) signs "more" after she finishes eating her banana slices. Will, her teacher, laughs and says, "You want more? Okay, I'll give you some more banana slices." He cuts up the rest of the banana, puts the slices in a bowl, and puts the bowl in front of her. She eats all of the banana slices. When the bowl is empty, Will signs and says, "All gone. Dani ate the whole banana. All gone!" He smiles at her and she smiles back.

Kamara (18 months old) sits on the living room floor and plays with an empty wallet and a small wooden block. Carol, the family child care provider, sits near her and watches. Kamara opens the part of the wallet that holds coins and tries several times to fit the block in it. Then she opens the part that holds bills and tries, without success, to fit the block in. Kamara looks over at Carol, who smiles and says, "You are trying to put the block in the wallet, but it doesn't seem to fit. What will you try next?" Kamara gets up and goes over to a low shelf that holds different types and sizes of bags. She selects a large canvas bag with handles and brings it back to where she was sitting. She picks up the block and drops it into the bag. Then she looks at the wallet, picks it up, and drops it in, too. She brings the bag to Carol and gives it to her. Carol claps her hands and exclaims, "Yay, you found something large enough to fit the block and the wallet!"

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*Rashid (34 months old), Ben (32 months old), and Summer, their teacher, are sitting together on a blanket outside, reading the boys' favorite book, *Jump, Frog, Jump!* Every time Summer reads the line "How did the frog get away?" Rashid and Ben get up and yell, "Jump, frog, jump!" and then jump up and down (like a frog, of course!) for a few moments before sitting back down.*

What do these children have in common? Each child, in his or her own way, demonstrates early mathematical thinking!

Infants and toddlers begin to develop math concepts and skills in the first years of life, but they are really natural mathematicians. In fact, new research shows that children may have innate (or inborn) understandings of math concepts that involve quantities.ⁱ Even without adult support, we see infants and toddlers using math concepts to make sense of their world. For example, young infants like Marshall begin to notice that something is different from what they already know. Becoming aware of how things are the same and different is an early concept for sorting and classifying. Infants like Dani show they understand the concept of **more**; more is one of the first number concepts that children develop.ⁱⁱ Toddlers like Kamara, Rashid, and Ben try to fit objects into various sizes of containers (spatial relationships) and predict words that are repeated in stories you read aloud or songs you sing (patterns).ⁱⁱⁱ Even though young children may already have some basic understandings, teachers, home visitors, family child care providers, and families still have a very important role to play. Infants and toddlers develop and refine math concepts and skills through everyday routines, experiences, and most important, caring interactions with trusted adults! Being aware of early mathematical concepts can help you be more intentional in how you support young children's math learning—and school readiness!

■ Where Is the Math?

Everywhere! Math, or **mathematics**, is "a way of describing the world—a way of thinking, knowing, and problem-solving."^{iv} You use math concepts and math language all the time, but may not realize it. For example, separating clothes into warm water and cold water piles for washing (sorting and classifying), keeping score at sports events and explaining how much your team is ahead or behind (numbers and operations), and giving someone directions to get from one place to another (spatial relationships) all involve math. In your work with infants and toddlers, you likely play games, sing songs, and read simple books that use numbers and counting, use comparison words such as **big** and **little** (measurement), and explain the order of everyday routines and experiences (patterns). All of those experiences support young children's early math learning. Math is all around us; creating an environment that supports early math learning and using the language of math, or "math talk," makes it concrete and visible for infants and toddlers.



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Components of Math

One way to recognize and support early math learning for infants and toddlers is to be familiar with what math involves. Here are brief descriptions of five math components and suggestions for incorporating early math concepts into daily routines and experiences.^v



Numbers and Operations

This component includes developing a sense of number (that numbers have meaning) and understanding concepts of quantity (how much), order (e.g., first, second), ways to represent numbers, one-to-one correspondence, and counting.

- Play games, sing songs, recite nursery rhymes, and read books that use numbers and counting. Gently bounce infants on your lap or knee and invite toddlers to clap or beat on a drum to a steady beat. Steady beats relate to number concepts such as counting and one-to-one correspondence (e.g., one bounce per beat, one clap per beat).
- Count out loud with children! There are so many things you can count both indoors and outdoors.
- Provide a variety of age-appropriate materials that support children's explorations with one-to-one correspondence, e.g., containers with lids, markers with tops. Invite older toddlers to help set the table for meals and snacks. Explain that each place at the table gets one plate, cup, napkin, and utensil.
- Use math talk as you describe what children see and do. For example:
 - o "You have *two* eyes, and so does your bear. Let's count: 1, 2."
 - o "I have *more* crackers than you do. See, I have *three* and you have *two*. I'm going to eat *one* of mine. Now I have *the same* as you!"
 - o "That's the *third* time I've heard you say 'mama.' You've said 'mama' *three* times!"

Shapes and Spatial Relationships (Geometry)

This component includes recognizing, naming, comparing, and contrasting objects based on their shape; and understanding the physical relationship (i.e., direction and position) between oneself and objects or between two or more objects in the environment.

- Play simple body games such as "This Little Piggy," "Open, Shut Them," and "Pat-a-Cake." Games like these help infants and toddlers develop a physical sense of where they are in space.
- Provide materials and equipment such as simple puzzles, different-sized boxes, tunnels, and age-appropriate climbing structures. These materials and equipment allow young children to physically explore spatial relationships such as *in*, *out*, *over*, *under*, *inside*, and *outside*.



- Provide materials and equipment such as simple puzzles, different-sized boxes, tunnels, and age-appropriate climbing structures. These materials and equipment allow young children to physically explore spatial relationships such as in, out, over, under, inside, and outside.
- Provide toys and blocks with different shapes for infants and toddlers to explore. In addition to learning the names of shapes, this helps them discover characteristics of shapes such as sides, corners, and curves.
- Use math talk as you describe what children see and do. For example:
 - o "Look, Jason went *under* the climber and Aliyah is on *top*!"
 - o "You're sitting *next to* Carlos."
 - o "Some of the crackers we have for snack today are *square*, and some are *round*."

■ Measurement

This component includes determining qualities such as size, weight, quantity, volume, and time and using the appropriate tools to do so.

- Provide a predictable daily schedule of routines and experiences. This helps infants and toddlers develop a sense of time (e.g., "what comes before" and "what happens next").
- Provide the same type of toy in different sizes, such as big and smaller blocks and balls, and toys that have graduated sizes, such as nesting cups, measuring cups, and stacking rings.
- Let infants and toddlers play with sand and water (as appropriate for their ages and stages) and various types and sizes of containers. Encourage them to fill, dump, pour, scoop, and weigh. This helps infants and toddlers begin to understand the concept of volume. And don't forget to provide plenty of adult supervision as children play with sand and water!
- Use math talk as you describe what children see and do. For example:
 - o "It's not easy to move that stool because it's *heavy*."
 - o "You took a *long* nap today!"
 - o "Let's count *how many* steps it takes to reach the playground."



■ Patterns, Relationships, and Change (the Building Blocks of Algebra)

This component includes recognizing patterns (i.e., seeing the relationships between things that make up a pattern) and/or creating repetitions of objects, events, colors, lines, textures, or sounds to make patterns; and understanding that things change over time and that change can be described using math words.

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- Provide a predictable daily schedule of routines and experiences. Predictable routines and experiences are also patterns that help infants and toddlers make sense of their world.
- Play “peek-a-boo” and hide toys as a way to facilitate **object permanence** (the concept that objects and people exist even if you can’t see them).
- Sing songs and do finger plays with repetitive words and phrases such as “Old MacDonald Had a Farm” and “Los cinco hermanitos.” Read books with repetitive language patterns such as *I Went Walking*.
- Point out patterns that occur indoors and outdoors. Make patterns with children using toys such as large beads and laces, small colored wooden blocks, and large colored pegs and pegboards. You can also make patterns with sounds and movements.
- Use math talk as you describe what children see and do. For example:
 - o “Marcus has stripes on his shirt—*white, blue, white, blue, white, blue.*”
 - o “I put the blocks in the bucket, you dump them out. I put the blocks back in the bucket, you dump them out! In, out, in, out, in, out!”
 - o “Our plant looks *taller* today. I think it grew overnight.”



Collecting and Organizing Information (Data Collection and Analysis)

This component includes gathering, sorting, classifying, and analyzing information to help make sense of what is happening in the environment.

- Point out how objects are the same and different. Draw children’s attention to characteristics such as color, shape, texture, size, and function (how the object is used).
- Organize the environment to help young

children know where toys and materials belong; for instance, put labels with pictures and words on shelves and containers, or put children’s photos and names on their cubbies. This helps young children practice sorting and categorizing.

- Provide collections of small toys and other safe objects such as shells and plastic bottle tops that older toddlers can sort and organize in different ways. Pay attention to any safety concerns with toys and objects if toddlers are in mixed-age groups with younger children.
- Use math talk as you describe what children see and do. For example:
 - o “You put the big lid on the big pot and the small lid on the small pot.”
 - o “You always smile when your mom sings to you!”
 - o “Let’s put the dolls in the basket and the balls in the box.”

Engaging Families

As you become more aware of and intentional about supporting early math learning throughout the day, share your knowledge with families and ask them what examples of math they see happening at home. Help them identify the many ways they already use math with their children.

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Work with them to find safe toys and other objects their infants and toddlers can use for math play (kitchens and dressers are often great places to find these things!) and opportunities during daily routines to use math talk with their children. For example, diapering, meal and bath times, walks around the neighborhood, and shopping trips are ideal times to count, point out shapes and sizes, talk about patterns, and describe how things are the same and different. Encourage families to use their home language. When families speak in their home language, they strengthen their relationship with their children and are more likely to have meaningful conversations using rich, descriptive words.^{vi}

Conclusion

Math is everywhere! There are lots of opportunities during the day for infants and toddlers to discover math concepts through play and exploration and to hear new math words. How many ways are you already using math in your interactions with the infants and toddlers in your care? How might you build on those experiences to intentionally offer more math in your time with them and their families? The more you engage infants and toddlers in math play and math talk and share your enjoyment of the experience, the better chance they have to develop the early math foundations that are so important for later math learning and learning in general!

*This *News You Can Use* is adapted from the following article:

Jan Greenberg, "More, All Gone, Empty, Full: Math Talk Every Day in Every Way," in *Young Children* (Washington, DC: National Association for the Education of Young Children, May 2012), 62–64.



ⁱNatalie Angier, "Insights From the Youngest Minds," *New York Times*, (2012, April 30), retrieved June 4, 2012, from <http://www.nytimes.com/2012/05/01/science/insights-in-human-knowledge-from-the-minds-of-babes.html?pagewanted=all>; Johns Hopkins University, "You Can Count On This: Math Ability Is Inborn, New Research Suggests," *ScienceDaily*, (2011, August 8), retrieved June 4, 2012, from <http://www.sciencedaily.com/releases/2011/08/110808152428.htm>.

ⁱⁱHerbert P. Ginsburg, H.P. Joon Sun Lee, & Judi Stevenson Boyd, "Mathematics Education for Young Children: What It Is and How to Promote It," *Social Policy Report* 22:1 (2008), 3–23, http://srcd.org/sites/default/files/documents/22-1_early_childhood_math.pdf.

ⁱⁱⁱJan Greenberg and Toni S. Bickart, *Math Right from the Start: What Parents Can Do in the First Five Years* (Washington, DC: Teaching Strategies, 2008).

^{iv}Virginia's Early Childhood Development Alignment Project, *Milestones of Child Development: A Guide to Young Children's Learning and Development from Birth to Kindergarten* (Richmond: Office of Early Childhood Development, Virginia Department of Social Services, 2008), 83, accessed July 19, 2012, www.earlychildhood.virginia.gov/documents/milestones.pdf.

^vJan Greenberg and Toni S. Bickart, *Math Right from the Start; Launching Into Literacy and Math: Nurturing Mathematical Thinking Skills* (birth -3), accessed June 4, 2012, from http://oldweb.madison.k12.wi.us/tnl/lilm/early_math/infants&toddlers/math_thinking_skills.html; Virginia's Early Childhood Development Alignment Project, *Milestones of Child Development*.

^{vi}Office of Head Start, A Family Note on Finding the Math (Washington, DC: U.S. Health and Human Services/ Administration for Children and Families, 2008), accessed July 19, 2012, <http://eclkc.ohs.acf.hhs.gov/hslc/tta-system/teaching/eecd/Domains%20of%20Child%20Development/Mathematics/AFamilyNoteon2.htm>.



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STUDY GUIDE *NEWS YOU CAN USE*
for *FOUNDATIONS OF SCHOOL READINESS.*
SUPPORTING EARLY MATH LEARNING FOR INFANTS AND TODDLERS

SUMMARY:

This *News You Can Use* (NYCU) describes five components of math and provides suggestions for how to support early math learning for infants and toddlers.



Key Messages:

- Even without adult support, infants and toddlers naturally use math concepts to make sense of their world.
- Adults use math concepts and math language in their own lives all the time, but may not realize it.
- Math for infants and toddlers involves five components: numbers and operations; shapes and spatial relationships (geometry); measurement; patterns, relationships, and change (building blocks of algebra); and collecting and organizing information (data collection and analysis).
- Being aware of early math concepts can help you be intentional in creating environments that support early math learning and in using “math talk” with infants and toddlers.



Think:

- Math is considered part of the cognition and general knowledge domain. What are some ways that early math learning relates to the other domains—social and emotional development, approaches toward learning, language and literacy, and physical development and health?



Reflect:

- Reflect back on your math experiences in school. How might those experiences affect how you support early math learning for infants and toddlers?
- Looking at your own activities, think about the ways you use math concepts and math language in your own daily life.



Discuss:

- Discuss how early math learning might help infants and toddlers get ready for preschool and beyond.
- Share examples from your observations of how the infants and toddlers you work with use math concepts or math talk.



Next Steps:

- Make a list of math talk words and phrases. Post a selection on the walls to help you notice math talk opportunities. If you go on home visits, bring the list with you to share with families to help them notice opportunities, too.
- Watch the webinar *Supporting the Intuitive Understanding of Early Math in Infants and Toddlers*, from the 17th Annual Virtual Birth to Three Institute. Listen for one or more new ideas to try or to share with a coworker or family.

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May 2014

NEWS YOU CAN USE

News for Head Start, Early Head Start, & Migrant/Seasonal Programs

INSIDE:

What Is Science? | The Scientific Process | Science Knowledge | Staff and Families Support Early Science | Science and School Readiness | Conclusion

EARLY SCIENCE LEARNING FOR INFANTS AND TODDLERS

Have you ever heard people say, “Science for infants and toddlers? That can’t be right!” Or, “I don’t know how to do that”? Or even “Science is for older children”? Science learning may seem to be the stuff of high school and college students, but it all begins with infants and toddlers!



What Is Science?

Science is not just a body of knowledge—it’s “a way of thinking and acting . . . a way of trying to discover the nature of things.”¹ Science learning at any age involves curiosity, exploration, and discovery. These come naturally to most infants and toddlers. Adults can help young children find answers to their questions and discover more about things that interest them. Do you do some of that already? If so, you’re helping them learn science!

Science is not just a body of knowledge—it’s “a way of thinking and acting . . . a way of trying to discover the nature of things.”

The Scientific Process

Fifteen-month-old Jasper is exploring a basket of different kinds of balls that his home visitor brought with her. Jasper finds a large, rubber bouncy ball. He hands it to his mother, Adria, and says “Ball.” Adria says, “Yes, it’s a rubber ball. Drop it and see what happens.” Jasper drops the ball, and it bounces back up to his waist. He laughs in delight. Adria laughs too and says, “It bounced. You like that!” Then he finds a plastic ball and says, “Ball!” When he drops this ball, it just lands on the floor and rolls. He looks at his mom with wide open eyes. Adria smiles and says, “Uh, it didn’t bounce. You look surprised! Here, try this one,” and hands him a larger bouncy ball. He drops it and it bounces back up to his knees. Jasper spends some time going through the basket of balls, dropping each one (and sometimes throwing one to the ground) to see if it bounces.

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Science has two parts: *process* and knowledge.² The scientific *process* (also known as the scientific method) is a series of steps. These steps do not have to happen in a certain order or just once. Sometimes they can happen at the same time. In this vignette, Jasper uses the same process that adult scientists use! As you read the steps, think about how Jasper and his mom explored the balls and the way he naturally followed the process:



1. Observing	Leads to forming questions or identifying a problem; often, questions lead to more observations.	Here's a ball. Does it do anything?
2. Developing one or more hypotheses (or "best guess")	Making educated guesses about answers to questions or solutions to problems; predicting what will happen. Adults (and older children with adult support) may first gather as much information as possible related to their initial question(s) before developing hypotheses or predictions.	I drop the ball. It bounces All balls bounce!
3. Investigating/experimenting	Testing hypotheses and predictions	I drop a different ball It doesn't bounce!
4. Analyzing results/drawing conclusions	How close do the results fit the hypotheses and predictions?	One ball bounces, one ball doesn't bounce. Maybe all balls don't bounce.
5. Communicating	Letting others know the results or findings; discussing the results with others	When the second ball doesn't bounce, I look at mom with a surprised look on my face.

An important part of the scientific process is modifying and repeating. This can mean changing the hypotheses and doing the same experiment. It can also mean keeping the same hypotheses and doing a different experiment! Modifying and repeating can happen at any time while a child explores. In the vignette, Jasper tries dropping (or throwing) each ball to find the ones that bounce after he "communicates" the results of dropping the plastic ball. Over time, and with lots of experiences like this, Jasper will learn more about balls, including why some bounce and why some don't! So, knowing about the scientific process helps adults recognize when young children naturally follow these steps.

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This knowledge also helps adults support the scientific process by providing children with appropriate materials, experiences, and interactions.

Science Knowledge

Heath (infant teacher) sits on a blanket with Clara (twenty-six months old) under a tree on the center's outdoor play space. Clara lies quietly on her back, looking up toward the tree branches where a shiny silver chime is hanging. Heath says, "Clara, I see you looking up at the chimes. Do you think we'll hear them make a sound today?" Just then, a gentle wind blows and the chimes tinkle. Clara says excitedly, "I hear them just now!" Heath laughs and says, "I guess the answer is 'yes'! Did you feel the wind? It blew and moved the chime, and the chime made a tinkling sound!"



Where can science learning happen? Everywhere and anywhere; it doesn't have to stay at the science table! In this everyday experience of being outside and noticing chimes, Heath helps Clara wonder about (hypothesize) whether the chimes will make a noise or not and connect blowing wind (something that cannot be seen) with the effect it can have on a solid object (causing the chimes to make a tinkling noise). As Clara has more experiences seeing and hearing the wind's effects on objects such as chimes, trees, streamers, and hair, she will begin to learn more about wind, such as what it is and what happens when it blows. She will also learn to connect the wind blowing with the sounds that some objects make and to predict what sounds she might hear before the wind blows.

If the scientific *process* is the "how" of science exploration, science knowledge is the "what." There are many ways to organize science knowledge. Here is one.³

- Physical science: exploring the properties of objects and materials, such as shape, color, texture, weight, temperature (e.g., hot, cold), solid, or liquid; how objects move, work, and change; what objects and materials are made of; sound and light
- Natural science: exploring the natural world of living things, including plants and animals; and exploring things related to the earth (e.g., dirt, rocks, sand, wind, weather, sun)
- Social science: exploring people—who they are (e.g., relationships between people), what they do, and where they live

How Might Staff and Families Support Early Science Learning for Infants and Toddlers?

Cristina, a family child care provider, has noticed the way that infants and toddlers naturally explore and behave like scientists. She watches five-month-old Liam explore large plastic snap beads with his mouth. He is learning about their properties! She notices that thirteen-month-old Hanna has discovered—through trial and error—that the couch is an excellent structure for pulling herself up,



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while large cardboard boxes are not as stable. Twenty-one-month-old Xander seems driven to discover what he can and cannot fit his finger into. Cristina believes that the children she cares for are curious and capable. They will discover more about the world around them than she could ever hope to “teach.” She knows that her nurturing relationship and safe home together create an inviting environment for learning.



Infants and toddlers learn best within strong, trusting relationships with caring adults. When infants and toddlers feel safe and comfortable, they are more likely to want to explore and learn about their world. And what do they use to explore and learn? Their senses—they watch, touch/feel, taste, smell, and listen! Infants and toddlers also learn through play. As Cristina realizes, offering sensory play opportunities and interacting in meaningful ways with very young children are part of supporting early science learning. Here are a few more ideas to consider:

- Provide an environment of “yes”⁴ and long chunks of time for children to observe and explore their environment (indoors and outdoors)—at their pace.
- Use language! Help children make sense of their experiences by describing what they see and do. Ask open-ended questions such as, “I wonder why...?” “What do you think will happen if...?” “What else can you try?” You can even ask young infants open-ended questions! They may not answer, but you are helping to develop their scientific thinking. Commenting, describing, making comparisons between objects/materials, and asking questions are all ways to help young children learn new words and connect new information to what they already know.
- Provide mobile infants and toddlers with discovery tools such as small pails and buckets with handles; small digging tools; and safe, sturdy magnifying glasses.
- Read books with children about nature, people, and familiar objects.



Science and School Readiness for Infants and Toddlers

Science in the early years can lead to a lifelong love of discovery. Science learning is also related to developmental domains and school readiness. For example, the scientific process steps are closely related to attention, curiosity, information gathering, memory, persistence, and problem solving. These are characteristics that are found in the Approaches Toward Learning domain.

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(See *News You Can Use: Approaches Toward Learning – Foundations of School Readiness*, [Parts 1, 2, and 3](#) for more information.) The following cognitive concepts also connect to early science learning:

- Object permanence (people and objects exist even when you can't see them);
- Cause and effect (actions make things happen);
- Spatial awareness (where bodies and objects are in space; recognizing the environment has three dimensions – that things have tops, bottoms, and sides); and
- Symbolic thinking (using objects, actions, and ideas to represent other objects, actions, and ideas)

(See *News You Can Use: Foundations of School Readiness: Cognition and General Knowledge* for more information.)

Conclusion

Infants and toddlers are natural scientists! They explore physical, natural, and social science anywhere and everywhere. They observe, are curious, and investigate to find out more about their world. They gather information as they solve problems. They communicate the results of their explorations through babbling, laughing, crying, physical gestures, facial expressions, and words. However, even though “science” exploration might come naturally to most infants and toddlers, they benefit from adult support. Adults build and expand on young children’s scientific interest when they interact with infants and toddlers as they engage in the scientific process. Adults also provide opportunities, materials, time, and space for exploring and discovery. This support from staff and families in the early years can lead to positive outcomes later as young children carry their interest and excitement about science and learning into preschool and beyond!



¹Rosalind Charlesworth and Karen Lind, *Math and Science for Young Children* (Clifton Park, NY: Cengage Learning, 2010), 76.

²Lauren F. Shaffer, Ellen Hall, and Mary Lynch, “Toddlers’ Scientific Explorations: Encounters with Insects,” In *Young Children* (Washington, DC: National Association for the Education of Young Children, November 2009), 18–23.

³Diane Trister Dodge, Sherrie Rudick, and Kai-leé Berke, *The Creative Curriculum for Infants, Toddlers & Twos: Volume 1-The Foundation* (Washington, DC: Teaching Strategies, 2011).

⁴Early Head Start National Resource Center, *News You Can Use: Environment as Curriculum for Infants and Toddlers* (Washington, DC: US Department of Health and Human Services/Administration for Children and Families/Office of Head Start, July 2010), http://eclkc.ohs.acf.hhs.gov/hslc/tta-system/ehsnrc/cde/learning-environments/environment_nycu.htm.

STUDY GUIDE NEWS YOU CAN USE

for FOUNDATIONS OF SCHOOL READINESS: EARLY SCIENCE LEARNING FOR INFANTS AND TODDLERS

SUMMARY:

This *News You Can Use* (NYCU) talks about the scientific process and building science knowledge for infants and toddlers. It also provides strategies that adults can use to support early science learning.



Key Messages:

- Infants and toddlers are natural scientists! They are curious and investigate to find out more about their world.
- The scientific process (also known as the scientific method) is a series of steps for exploring questions and discovering answers. It is the “how” of science exploration.
- Science knowledge is the “what” of science exploration. It includes learning about physical science, natural science, and social science.
- Early science learning is related to developmental domains and school readiness.
- There are many ways adults can help young children find answers to questions and discover more about things that interest them.
- There are many ways adults can help young children find answers to questions and discover more about things that interest them.



Think:

- This NYCU provides some examples of how early science learning relates to two developmental domains: (1) approaches toward learning and (2) cognition and general knowledge. What are some examples of how early science learning relates to social and emotional development, language and literacy, and physical development and health?
- How do engaging in the scientific process and learning about physical, natural, and social science help infants and toddlers become ready for preschool and beyond?



Reflect:

- Reflect on your own experiences with science learning in school. Were they positive or negative? Can you say why?
- How might your personal feelings about science affect how you support early science learning for infants and toddlers?



Discuss:

- How might early science learning look the same or differently for young infants, older infants, and toddlers?
- In what ways do you already support early science learning for infants and toddlers?



Next Steps:

- Read one or more of the following NYCU editions: *Take It Inside* (January 2012); *Take It Outside* (January 2012); and *Outdoor Spaces* (March 2012). Look for a new early science learning idea to try with the infants and toddlers you work with.
- Plan ways to share what you know about the scientific process and science knowledge with families. Work with families to find ways they can support their child’s early science learning at home.

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TIPS FOR TEACHERS FOSTERING CHILDREN'S THINKING SKILLS

Fostering children's thinking skills is important for children's ability to understand bigger ideas in their lives and the world around them. Teachers can effectively foster thinking skills by:

- Using the scientific method to provide tasks where children can observe, predict, and experiment.
- Creating opportunities for children to solve problems.
- Helping children apply knowledge by building on their natural curiosity and drawing upon their everyday experiences.

WHAT STRATEGIES CAN I USE TO FOSTER CHILDREN'S THINKING SKILLS?

Here are some suggested strategies and examples of what this looks like in action. There are many other ways children's thinking skills can be encouraged. Please note that some examples may include more than one strategy.

Create opportunities for children to **solve problems, experiment**, and figure out how things work.

What this looks like in action:	What it is not:
When children are building towers with blocks, the teacher asks, "What do you think will happen if we add more blocks? Why do you think that?" The teacher then asks children to add more blocks and talk about what happens. This allows children to experiment and learn more from the activity.	When children are building towers with blocks, the teacher asks, "How many blocks does this tower have?" (and asks nothing else).

Make learning meaningful and **connected to children's lives**.

What this looks like in action:	What it is not:
When going outside for a spring nature walk, a child notices flowers blooming. The teacher says, "Tell me about what you see coming out of the ground. Why are the flowers coming out now? Why didn't we see them last month? Have you seen flowers like this at home or somewhere else?" This helps children deepen their understanding of their world.	When going outside for a spring nature walk, the teacher says, "Let's count the number of flowers we see," and encourages no other activity on the walk.

Use **how and why** questions that help children think about ideas.

What this looks like in action:	What it is not:
When reading a story, the teacher asks questions, such as: "How do you think that made her feel? Why do you think that?" to help children think more deeply about the book.	When reading a story, the teacher asks children, "What is the name of this animal?" or "What color is the house?" with a focus on the right answer.

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Link understanding with something previously learned.

What this looks like in action:	What it is not:
Children are in a center time and playing store, buying and selling various items. The teacher reminds the children about their visit to a store the day before and connects what they saw and did with the current activity.	When children are in center time, the teacher observes their interactions and asks if they are having fun.

Predict what may happen next.

What this looks like in action:	What it is not:
When reading a book, the teacher asks questions, such as: "What do you think will happen next?" to help children with their prediction skills.	When reading a book, the teacher reads the book without asking questions, and does not encourage children to talk.

Brainstorm new ideas, make something in a new way.

What this looks like in action:	What it is not:
When coloring, the teacher asks children to draw pictures of animals that lay eggs. After the children are done with their drawing, the teacher and children sit together and make a list of all the animals they came up with.	When coloring, the teacher tells children to draw dogs that look just like the picture on the board.

Compare and contrast to understand similarities and differences.

What this looks like in action:	What it is not:
When eating lunch, the teacher talks with children about what fruit they see at the table and asks children to compare the shapes and colors.	When eating lunch, the teacher does paperwork while the children eat.

When during the day can I do this?

Children's thinking skills can be promoted throughout the school day in many classroom activities including centers, whole group instruction, meal and snack time, as well as transition. What is important is that teachers think intentionally about finding opportunities to do this at different times during the day, and not just during a structured instructional activity.

NOTE: Please note that the strategies for "What this looks like in action" and "What it is not" are examples specific to those strategies. The behaviors in the nonexamples may be appropriate in other instances depending on children's learning goals.

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ESPAÑOL/SPANISH
CONSEJOS PARA MAESTROS
FOMENTAR LAS HABILIDADES DE PENSAMIENTO DE LOS NIÑOS

Fomentar las habilidades de pensamiento de los niños es importante para que ellos comprendan ideas más complejas en sus vidas y en el mundo que los rodea. Los maestros pueden fomentar las habilidades de pensamiento con eficacia al:

- Utilizar el método científico para proporcionar tareas en las que los niños puedan observar, predecir y experimentar
- Crear oportunidades para que los niños resuelvan problemas
- Ayudar a los niños a aplicar el conocimiento aprovechando su curiosidad natural y recurriendo a sus experiencias cotidianas.

¿QUÉ ESTRATEGIAS PUEDO UTILIZAR PARA FOMENTAR LAS HABILIDADES DE PENSAMIENTO DE LOS NIÑOS?

A continuación se incluyen algunas estrategias sugeridas y algunos ejemplos de cómo se manifiesta esto en la práctica. Existen muchas otras maneras de estimular la capacidad de comprensión de los niños. Tenga en cuenta que algunos ejemplos pueden incluir más de una estrategia.

Crear oportunidades para que los niños **resuelvan problemas, experimenten** y averigüen cómo funcionan las cosas.

¿Cómo se manifiesta esto en la práctica?	Lo que no es:
<p>Cuando los niños construyen torres con cubos/bloques para armar, el maestro pregunta: "¿Qué creen que sucederá si añadimos más cubos/bloques?... ¿Por qué creen eso?" El maestro pide entonces a los niños que agreguen más cubos/bloques y hablen acerca de lo que sucede. Esto les permite a los niños experimentar y aprender más de la actividad.</p>	<p>Cuando los niños construyen torres con cubos/bloques para armar, el maestro pregunta: "¿Cuántos cubos/bloques tiene esta torre?" (Y no pregunta nada más.)</p>

Hacer que el aprendizaje sea significativo y que **esté conectado con la vida de los niños.**

¿Cómo se manifiesta esto en la práctica?	Lo que no es:
<p>Estando fuera durante una caminata por la naturaleza en primavera, un niño nota que están brotando las flores. El maestro dice: "Cuéntame acerca de lo que ves saliendo de la tierra," "¿Por qué están saliendo las flores ahora? ¿Por qué no las vimos el mes pasado?"; "¿Has visto flores como éstas en casa o en otra parte?". Esto ayuda a los niños a profundizar su comprensión del mundo.</p>	<p>Al salir fuera para hacer una caminata por la naturaleza en primavera, el maestro dice: "Contemos la cantidad de flores que veamos," y no promueve ninguna otra actividad durante la caminata.</p>

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Vincular la comprensión con algo que se aprendió previamente.

¿Cómo se manifiesta esto en la práctica?	Lo que no es:
Los niños están en el tiempo de los centros, y juegan a la tiendita, comprando y vendiendo diversos artículos. El maestro les recuerda de su visita a la tienda el día anterior y conecta lo que vieron e hicieron con la actividad actual.	Cuando los niños están en el tiempo de los centros, el maestro observa sus interacciones y les pregunta si se están divirtiendo.

Utilizar preguntas con “cómo” y “por qué” que ayudan a los niños a pensar en ideas.

¿Cómo se manifiesta esto en la práctica?	Lo que no es:
Al leer un cuento, el maestro hace preguntas, tales como, “¿Cómo creen que eso la hizo sentir?”, “¿Por qué piensan eso?” para ayudar a los niños a pensar con más profundidad acerca del libro.	Al leer un cuento, el maestro pregunta a los niños: “¿Cuál es el nombre de este animal?” o “¿De qué color es la casa?” enfocándose en la respuesta correcta.

Predecir lo que podría suceder a continuación.

¿Cómo se manifiesta esto en la práctica?	Lo que no es:
Al leer un libro, el maestro hace preguntas tales como “¿Qué creen que sucederá a continuación?” para ayudar a los niños con sus habilidades de predicción.	Al leer un libro, el maestro lee sin hacer preguntas, y no alienta a los niños a que hablen.

Generar e intercambiar nuevas ideas; hacer algo de una manera novedosa.

¿Cómo se manifiesta esto en la práctica?	Lo que no es:
Mientras dibujan/colorean, el maestro pide a los niños que hagan dibujos de animales que ponen huevos. Cuando los niños terminen con sus dibujos, el maestro y los niños se sientan juntos y hacen una lista de todos los animales que se les ocurrieron.	Mientras dibujan/colorean, el maestro les dice a los niños que dibujen perros que se parezcan a la imagen en la pizarra/el pizarrón.

Comparar y contrastar para entender las similitudes y las diferencias.

¿Cómo se manifiesta esto en la práctica?	Lo que no es:
Mientras almuerzan, el maestro habla con los niños acerca de qué frutas ven en la mesa, y les pide que comparen formas y colores.	Mientras almuerzan, el maestro trabaja en su papeleo/gestiones mientras los niños comen.

¿En qué momento del día debería hacer esto?

Se puede promover la capacidad de comprensión de los niños durante todo el día escolar con muchas actividades en el aula, incluyendo los centros, la instrucción con el grupo entero, durante el almuerzo y los bocadillos/la merienda así como durante las transiciones. Lo importante es que los maestros piensen deliberadamente en encontrar oportunidades para hacer esto en diferentes momentos durante el día, y no únicamente durante una actividad didáctica estructurada.

NOTA: Por favor note que las estrategias para “Cómo se manifiesta esto en la práctica” y “Lo que no es” son ejemplos específicos para esas estrategias. Los comportamientos en los ‘ejemplos negativos’ pueden ser apropiados en otras instancias, de acuerdo con las metas de aprendizaje de los niños.

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TIPS FOR TEACHERS MAKING LEARNING MEANINGFUL

Making Learning Meaningful is important to children’s understanding of the learning concepts and the world around them. Teachers make learning meaningful when they:

- Link new learning to children’s previous experience.
- Relate concepts to children’s lives.
- Provide children with hands-on learning.

WHAT STRATEGIES CAN I USE TO MAKE LEARNING MEANINGFUL FOR CHILDREN?

Here are some suggested strategies and examples of what this looks like in action. There are many other ways children’s learning can be made meaningful. Please note that some examples may include more than one strategy.

Create opportunities to link children’s NEW KNOWLEDGE to WHAT THEY HAVE LEARNED.

What this looks like in action:	What it is not:
When playing on the playground the children see beetles on the grass. The teacher says, “We talked about different kinds of insects when we read our story this morning. What kind of insects do you see?”	When on the playground the children see a beetle and the teacher says, “Oh look, there’s a beetle. Can you say beetle?”

Relate new learning to CHILDREN’S EVERYDAY LIVES.

What this looks like in action:	What it is not:
While playing with clay at centers, the teacher makes a clay taco shell. She asks the children, “What should I put in my taco? What do you eat in your tacos at home?”	When playing with clay at centers the teacher makes a taco and fills it herself, saying, “Look, I made a taco.”

Bring concepts to life by PUTTING LEARNING INTO ACTION.

What this looks like in action:	What it is not:
After spending a week learning about construction through books and having a “construction center,” the teacher arranges for kids to visit a local construction site to see how concrete is poured out of the concrete mixer.	Kids are taught about construction through reading books and looking at pictures of a construction site.

NOTE: Please note that the strategies for “What this looks like in action” and “What it is not” are examples specific to those strategies. The behaviors in the nonexamples may be appropriate in other instances depending on children’s learning goals.

WHEN DURING THE DAY SHOULD I DO THIS?

Making learning meaningful for children can be accomplished throughout the school day in many classroom activities, including centers, whole group instruction, meal and snack time, as well as transition. What is important is that teachers think *intentionally* about finding opportunities to do this at different times during the day, and not just during a structured instructional activity.

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ESPAÑOL/SPANISH

CONSEJOS PARA MAESTROS HACER QUE EL APRENDIZAJE SEA SIGNIFICATIVO

Hacer que el aprendizaje sea significativo es importante para la comprensión de los niños de los conceptos por aprender y del mundo que les rodea. Los maestros hacen que el aprendizaje sea significativo cuando:

- Conectan el aprendizaje nuevo con las experiencias previas de los niños.
- Relacionan conceptos con la vida de los niños.
- Proporcionan oportunidades de aprendizaje práctico para los niños.

¿CUÁLES ESTRATEGIAS PUEDO USAR PARA HACER QUE EL APRENDIZAJE SEA SIGNIFICATIVO PARA LOS NIÑOS?

A continuación se sugieren algunas estrategias con ejemplos de cómo se ven en la práctica. Hay muchas otras maneras en que se puede hacer que el aprendizaje de los niños sea significativo. Favor de notar que algunos ejemplos pueden incluir más de una estrategia.

Crear oportunidades para conectar el CONOCIMIENTO NUEVO de los niños con lo que YA HAN APRENDIDO.

Cómo se ve esto en la práctica:	Lo que no es:
Al estar jugando en el patio de juegos, los niños ven escarabajos en el césped. La maestra dice, "Hablamos acerca de diferentes tipos de insectos cuando leímos nuestro cuento esta mañana. ¿Qué tipo de insectos ven ahora?"	Al estar en el patio de juegos, los niños ven un escarabajo y la maestra dice, "Oh miren, hay un escarabajo. ¿Pueden decir escarabajo?"

Relacionar el aprendizaje nuevo con LA VIDA COTIDIANA DE LOS NIÑOS.

Cómo se ve esto en la práctica:	Lo que no es:
Al estar jugando con el barro/la arcilla a la hora de los centros, la maestra modela el barro en forma de taco abierto. Le pregunta a los niños, "¿Qué le pongo a mi taco? ¿Qué comen ustedes en sus tacos en casa?"	Al estar jugando con el barro/la arcilla a la hora de los centros, la maestra modela el barro en forma de taco y lo llena ella misma diciendo, "Miren, hice un taco."

Dar vida a los conceptos al HACER QUE EL APRENDIZAJE SEA ACTIVO.

Cómo se ve esto en la práctica:	Lo que no es:
Después de pasar una semana aprendiendo acerca de la construcción a través de los libros y de tener un "centro de la construcción," el maestro hace los trámites para que los niños visiten un sitio local de construcción, para que vean cómo sale el concreto de la mezcladora de concreto.	Se les enseña a los niños acerca de la construcción a través de leer libros y ver imágenes de un sitio de construcción.

NOTA: Favor de notar que las estrategias para "Cómo se ve esto en la práctica" y "Lo que no es" son ejemplos específicos a esas estrategias. Los comportamientos en los contraejemplos pueden ser apropiados en otras circunstancias, dependiendo de las metas de aprendizaje de los niños.

¿CUÁNDO DEBERÍA HACER ESTO DURANTE EL DÍA?

Se puede lograr hacer que el aprendizaje sea significativo para los niños durante todo el día escolar en muchas actividades en el aula, incluyendo los centros, la instrucción con el grupo entero, las horas de comida y bocadillos/merienda, así como las transiciones. Lo importante es que los maestros piensen *intencionalmente* en encontrar oportunidades para hacer esto en diferentes momentos durante el día, y no nada más durante una actividad didáctica estructurada.

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TIPS FOR TEACHERS USING THE SCIENTIFIC METHOD

The scientific method is a series of steps that help children understand their world. Below is a guide to help teachers encourage children to use this process in the classroom. Please note these steps may not always occur in this order (e.g., a teacher might ask students to make predictions prior to observing). It is important for teachers to be intentional and incorporate the steps of the scientific method across various activities. Strategies used in the scientific method (e.g., questioning, experimenting, etc.) can be used to support children’s learning across several other domains of the Head Start Child Development and Early Learning Framework (see other supporting documents from the scientific method in-service suite for examples).

Steps of the scientific method:

Some possible suggestions:



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CONSEJOS PARA MAESTROS USANDO EL MÉTODO CIENTÍFICO

El método científico es una serie de pasos que ayuda a los niños a comprender su mundo. A continuación se da una guía para ayudar a los maestros a alentar a los niños a usar este proceso en el salón de clases. Nótese por favor que puede ser que estos pasos no siempre ocurran en este orden (ej., un maestro podría pedirles a los niños que hagan predicciones antes de observar). Es importante que los maestros sean intencionales e incorporen los pasos del método científico a través de varias actividades. Se pueden utilizar estrategias usadas en el método científico (ej., preguntar, experimentar, etc.) para apoyar el aprendizaje de los niños a través de varios otros dominios del Marco de Head Start para el desarrollo y aprendizaje temprano de los niños (para ejemplos, véase otros documentos de apoyo del conjunto de materiales sobre el método científico).

Los pasos del método científico:

Algunas posibles sugerencias:

PREGUNTAR

Ayudar a los niños a formular sus propias preguntas relacionadas con su mundo.

Inducir a los niños a crear preguntas relacionadas con el tópico actual.

OBSERVAR

Pedirles a los niños que usen sus sentidos y que observen de cerca al mundo a su alrededor.

Alentar a los niños a ver, oír, oler, saborear y tocar materiales cuando sea apropiado.

PREDECIR

Alentar a los niños a predecir, o adivinar, la respuesta a su pregunta.

Pedirles a los niños que compartan, en base a sus observaciones, lo que ellos creen que podría ser la respuesta a su pregunta.

EXPERIMENTAR

Proporcionar oportunidades para que los niños experimenten y prueben sus predicciones.

Incorporar actividades prácticas para niños que les permita probar sus predicciones.

ANALIZAR

Permitir a los niños analizar los resultados de su experimento.

Hablar acerca de los resultados del experimento y repasar los puntos claves aprendidos.



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