What are the measurement skills of a young child?

Measurement is one of the most widely used applications of mathematics, bridging number and geometry. The process of measurement is based on three fundamental components. They are:

1. conservation of size (an object maintains its same shape and size if it is moved or partitioned)
2. transitivity (if object A is less than B and object B is less than C then object A is less than C)
3. unit (the number and size of units is consistently used for the measurement of one object).

While Piaget’s research suggests that young children ignore measurement concepts, others challenge this, suggesting children at younger ages may be able to achieve these concepts.
A young child’s first experiences with measurement should be informal and focused on direct comparisons of objects. They make decisions about size by looking, touching, and comparing objects directly while building language to express the size relationships. As teachers of young children, we need to focus on properties to be measured including length, area, volume, weight, and time, giving children many opportunities to make direct comparisons.

For more information about theories behind developing measurement skills, see Children’s Thinking about Measurement and the Teacher’s Role from TEXTEAMS Mathematics Institute Pre-Kindergarten/Kindergarten.

**From the Texas Prekindergarten Curriculum Guidelines**

The child:

- Covers an area with shapes (e.g., tiles)
- Fills a shape with solids or liquids (e.g., ice cubes, water).
- Begins to make size comparisons between objects (e.g., taller than, smaller than).
- Begins to use tools to imitate measuring.
- Begins to categorize time intervals and uses language associated with time in everyday situations (e.g., "in the morning," "after snack").
- Begins to order two or three objects by size (seriation) (e.g., largest to smallest) (age 4).

**Clarifying Activities:**

**Activity:**

*Balancing Act (Weight)*

To begin, give children two small classroom objects to hold, one significantly heavier than the other. Ask them which is the heaviest? Place objects in the balance scales. "What happens?" Repeat with two other objects.

Tell the children that the balance scale shows which object is heavier and ask the children "How does the scale show us which is heavier?" Test this again with two more objects.

This is an activity that can be introduced in circle time, then in small group, and used at the manipulative station constantly changing the group of small objects for children to investigate. Encourage the children to predict which is heavier (or lighter) before they use the balance scale.

**Questions to ask:**

**Start with:**
• How does the scale show you which one is heaviest?

**Probe further with:**

• Which is lightest? How do you know?
• Which is heaviest? How do you know?
• How do you think the scale would look if they were the same weight? How could you check this? Were you right?
• Can you find a small object heavier than this one?
• Can you find two objects that together are about the same weight as this one? How could you tell?

**Listen for:**

• Does the child use appropriate language when comparing the weight of the objects?

**Look for:**

• Can the child compare the weight of objects?
• Does the child know how to use the scale to compare the weight of objects?

**Activity:**

*I'm so big! (Length and Area)*

What’s bigger, your hand or your shoe? Trace the children’s hands and shoes. Children cut them out and compare their length. Children glue paper mosaics to cover the traced hand and shoe.

**Questions to ask:**

**Start with:**

• Which is longer, your hand or your shoe?

**Probe further with:**

• How do you know which is longer? How did you decide this?
• Which is shorter? How do you know?
• Do you think it takes more paper squares to cover your hand or your shoe? Why?
• How can you figure this out?

**Listen for:**

• Can the child make size comparisons between his/her hands and shoes?
• Can the child begin to explain his/her thinking?
What to look for:

- Does the child cover the area of the hand and shoe outline with shapes in an organized fashion with little overlap?

Activity:
Fill it up: Capacity

Provide a variety of shapes and sizes of containers and encourage children to compare capacities. Use a variety of materials at the sensory table such as corn meal, sand, cornstarch, wood shavings, shaved ice (to discuss temperature), packing peanuts, or colored and/or scented water.

Questions to ask:

Start with:

- What holds more, this cup or this container? How could you find out?

Probe further with:

- How many of these cups do you think you will need to fill this container? Check and see.

(After the child puts one cup of water in the container)

- Do you still think that the container will contain ___ cups? Why? 
- Will it take the same number of these (larger) cups to fill the container? Why?

Check and see.

- Why do you think this happened?

(Note: I don't expect the children to be able to answer all of the above questions accurately, but I want to hear their thinking. Very often I am surprised that they know more than I expected. Whether they answer the questions correctly or not, the questions may get the children to begin attending to unit.)

What to listen for:

- Does the child use words that compare the capacity of the containers?

What to look for:

- Does the child completely fill the cup to compare with the capacity of the container?
- Is the child beginning to attend to unit? That is, does the child recognize that the number of
cups it takes to fill a container depends on the size of the cups?

Math All Day: Centers and other Times

The mathematical content that is described in the Prekindergarten Curriculum Guidelines is integrally tied to the ways the classroom is structured and the types of experiences children encounter. Young children need opportunities to explore their world and experience mathematics through their play. Most mathematics learning in the early years does not require sitting down for group lessons. However, although learning is often informal, it is intentional and deliberate. Careful planning is required to build upon and extend the informal knowledge of the child. In Preschool and Prekindergarten classrooms, management techniques and room arrangements are of utmost importance. SEE books by Jean Feltman (For example, A Survival Guide for the Preschool Teacher) for classroom management ideas.

Well-placed discovery centers provide hands-on learning experiences that can engage children in mathematical thinking. All centers should all be equipped with writing tools so children can represent their mathematical thinking. You may rotate if you do not have room for all of the following centers in your classroom all year. Suggested centers include:

- An **Arts and Crafts Center** with plenty of markers, crayons, stamps, glues, watercolors, buttons, shells, clay, and other items for exploring, representing, and communicating. The materials should be easily accessible in sorted containers that the children are responsible for maintaining.
- A **Manipulative Center** with pegs and peg boards, interlocking blocks, beads, puzzles, and other items to sort, match, pattern, count, put together, and take apart.
- A **Sensory Table** filled with sand, rice, beans, leaves, water, ice, or other items. Include a variety of containers for pouring and measuring or small toys and other items for exploring other mathematical ideas such as patterning.
- A **Block Area** with blocks of various sizes and shapes for constructing and exploring.
- A **Dramatic Play Center** with number rich props such as an imaginary class phone directory, old phone books, play money, price tags, cash registers, bathroom scale, scales to weigh plastic fruit and vegetables, measuring cups and other items to recreate settings children experience in their lives.
- A **Literacy Center** with a chalkboard, felt-board, listening center, puppets and stage, and word display (that includes alphabet and numerals) for exploring and communicating mathematical ideas.
- A **Construction Center** with non-retracting measuring tools, empty boxes, straws, PVC, pulleys, hardhats, safety goggles, large nuts and bolts,
aluminum foil, clay twine, blocks with holes, brads, dowel rods, paint stir sticks and other items to explore structures, measurement, spatial reasoning, and other mathematical ideas.

- **A Music and Creative Movement Center** that has a large open area with a tape player, various musical instruments (store bought and child created), story props, scarves, streamers, pompoms and a wide variety of tapes with a wide variety of music styles for developing patterning, one-to-one correspondence, number sense, and communication skills.

**Block Center:**

*The Biggest*

Challenge two small groups of children to build the biggest tower in the block area. Encourage the children to work together and communicate with each other. Encourage them to compare the towers in a variety of ways (such as tallest, widest, containing the most blocks).

**Sensory Table:**

*Fill It Up!*

Provide a variety of shapes and sizes of containers and encourage children to compare capacities. Use a variety of materials at the sensory table such as corn meal, sand, cornstarch, wood shavings, shaved ice (to discuss temperature), packing peanuts, or colored and/or scented water. Ask questions such as how many of these cups do you think you will need to fill this container?

**Make Goop**

**Manipulative Center:**

*Box inside of box inside of box*

*How many bugs in a box?*

Complementing the story, add small boxes and plastic bugs of different sizes to explore how many bugs will fill the box. Listen for language such as more, fewer, same. With small boxes and large bugs, encourage them to count.

**Art and Crafts Center:**

*Cover it.*

Ask the children to glue different shapes on paper to cover the paper.

**Snack Center:**
Make snack time a station. Ask children to serve themselves one cup of a mixed snack (such as raisins and tiny crackers). Ask children to sort the snack before they begin to eat it. Ask questions such "Is your snack made up mostly of raisins or crackers?" Encourage the children to compare of number, size of the amounts, and weight of snacks to answer this question.

**Creative Movement:**

Play Follow the Leader, Simon Says, or Teacher May I, using large steps and tiny steps.

**Walking Tour:**

Yarn Measures Up!!!

The children take a ball of yarn and scissors and measure how far it is from the classroom to the end of the hall way, to the playground, around the school, to the P.E. classroom, Music room, Cafeteria, etc. The children and teacher lay the yarn pieces side-by-side on the playground to see which one is the longest, shortest, same, etc. This is a really fun way to measure things in the children's environment.

**Teacher Tips**

**How do children think about measurement?**

- Children's perceptions of age are interesting... People wearing glasses, having hand wrinkles, or short hair are older.
- A 4 year old explains, "Mommie is 20, and you are 50, and you have a daughter who is 22. That means that you could be the mother of my mother."
- When children put their hands in shaved ice in the water table, they were surprised when it was cold.

**How do you instruct?**

**Length:**

- Children use their own body to explore measurement. Each child makes foot prints and hand prints, these are placed in a basket and used throughout the year to measure.
- children make play-dough snakes and children measure using them
- huge alligator and crocodile.
- Children measure how big they are. They compare and order by height.
- Our Drama Center can be a store. Children compare shoe sizes in shoe store center... big shoes, high heel shoes. men's and women's shoes, scarves.
**Time:**

- To develop a sense of time, we use timers. Children do things until the timer is finished.
- I teach time by using a schedule: Our Mickey Mouse® clock has colored stars that represent when the next activity is to begin. (journal: red star, calendar: blue star, songs/movement: yellow star, poem of the week, etc.)
- We use this Calendar saying:
  Yesterday is over and gone. You can’t fix yesterday. Today is now, choose what kind of day you are going to have. Tomorrow has not come yet, wait your turn (Wednesday), see you soon (green) balloon (each day has its own color balloon and the balloon is popped when the day is over.)
- So that the children are not always asking when it is time to get backpacks to go home, I bring attention to the clock at the end of the day. Now they don’t ask, the children know when the clock looks like this, it’s time.
- I teach time with a calendar. We talk about days of the week and refer to weekends as sleepovers. I also teach position words and left to right with the calendar.
- I have a multi-age class. We talk about birthdays and compare oldest... and youngest. I hear the children compare ages including half years. Eva says that she is four and a half. Roberto says he is three and a half. Pierce says he is four but soon he will be four and a half.
- To sequence time, I collect my children’s work. My children make masks, schedules, card pictures. Children turn the picture over when they have finished, cards are put in different orders depending on the day. They can also count backwards to find out what they did first, second, (Ask Linda)
- I show the time schedule. It is shown as a pattern..... circle time, center time, storytime, etc. Then, after Christmas it is a circular schedule, labeled with photos and words for each event. Children start at a different place everyday and just follow the pattern.

**Capacity**

- I ask children to compare and order capacity of container, use contains exactly the same width first... one attribute only.
- We have a cooking center. We make Jello®, pudding, pancakes, etc., incorporating health issues.

**How do children represent?**

- My children put stickers on rulers like a totem pole... represents a non-standard tool.
- My children draw an alligator and show how they measure it.
- We use Unifix® cube trains to match a particular measurement.
How do you connect?

- I use thematic units. One example is Tails. We explore whose tail is this. My children measure different tails and they guess whose they are. The children compare a pig’s tail to a mouse’s tail. They stretch them out to see which one is longest.
- I use many connections in science.
- I have a unit on boxes. The children create, glue, and make sculptures with paper towel rolls. We have a group activity in which children measure the size of their creation.
- We do a unit on tools along with community helpers. For 3 weeks we investigate a variety of different tools, discuss safety, and include many measuring tools (real and child-like, metal and plastic). A level with a bubble is one of their favorites.

How do you incorporate problem solving?

- We ask questions.

What questions do you ask?

- How many kids can fit into huge boxes? How could we find out?
- Why do you think it takes more of Jose’s feet to measure the table than Jennifer’s feet?
- How did you decide the tool to use to measure?
- Tell me exactly how you did it so I can tell someone else.
- What is taller... shorter? 1
- What is heavier... lighter?
- What holds the most? .... the least?
- What is loud and soft?
- How many days until? Is that very long?

How do children communicate?

- We talk about comparison words, light as a feather or heavy as an elephant.
- Oral communication is especially encouraged in my classroom. My job is to expand their words and help my children express themselves.

How do you encourage reasoning?

- I use non-standard measure and set up cases for children to notice the importance of unit and a standard unit. We fill pickle jars with tennis balls and then marbles. We discuss when the jar is full.

How do you encourage parent/family relationships?
Children take models of their feet home to find out measurements in their home.

What tools do you use for measurement?

**Length:**

- We use blocks.
- We use toilet paper (as long as your arm).
- We use string to measure heights. We compare heights throughout the year with the string.
- We use a tape measure (children do not know how to use it but they pretend).
- We use different sizes of rulers with different sizes of stickers used as totem poles and ask children to measure and compare.
- We use plastic links to measure.
- We use Unifix® cubes in sets of 10, red, white, blue.

**Weight:**

- We use balancing scales that are simple and flat.
- We use bears that are calibrated so that 2 equal 1 of another or three equal 1 of another for weight.
- To compare weights, we use pebbles, feathers, and other natural stuff.

**Capacity:**

- We use a variety of cups, 1
- We have a pound scale in housekeeping center (children do not know how to use it but they pretend).
- We use wood shavings, Easter grass and eggs (fill up), noodles, beans, rice, corn meal, sand, cornstarch, ice cubes, Kool-Aid, or shaved ice in the Sensory Table. I sometimes put food coloring in water or pineapple extract and chocolate extract. In addition, I add extract to Playdough for good smell.
- We have standard cup, measuring spoons, funnels, sifter in the Sensory Table and at the Dramatic Play Center.
- I use stretchy gloves to measure capacity.

**Time:**

- We use sand timer.
- We use calendars.
- I have clocks prominently displayed in my room and I use egg timers to encourage sharing time at the technology center.

**Sequencing:**
• We use deer corn in large, medium, and small pans. Children count shovels with large, medium, and small shovels
• Temperature:
• We have a thermometer (children do not know how to use it but they pretend).
• I use shaved ice in the sensory station to explore cold.

**Book Corner**


Hutchins, Pat. *You'll soon grow into them, Titch*. Morrow/Avon.


Lionni, Leo. *Inch by Inch*. Astor-Honor.

Myller, Rolf. *How Big is a Foot?* Dell Publishing.

Myers, Maggie. *Not Long Enough*. The University of Texas, Dana Center.

Walsh, Ellen S. *Mouse Count*. Harcourt.


*Ten Beads Tall* by Pam Adams
Twelve Snails to One Lizard: A Tale of Mischief and Measurement. by Susan Hightower, Matt Novak (Illustrator)

A tale of Mischief and Measurement Simon and Schuster

Measuring Penny

by Loreen Leedy (Illustrator) Holt

Inchworms from Creative .... OH transparencies inchworms that children use