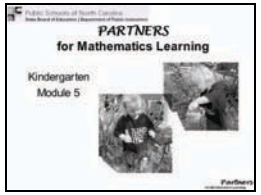
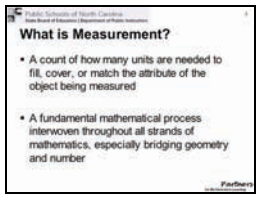
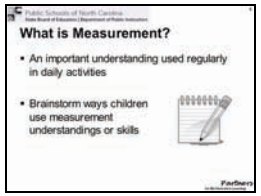
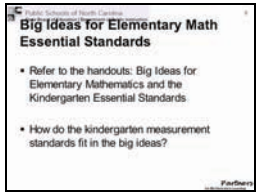
General Materials and Supplies: *The Best Bug Parade*; "Shorter, Same, Longer" chart or drawing on board (see Slide 16); one referent object for presenter for comparing length (child's belt, boot shoelace, length of ribbon or adding machine tape); one piece of adding machine tape or ribbon for each table (various lengths compared to the referent object); 6-8 nontransparent containers labeled A-H and filled to different weights, one per table; 6-8 teddy bears, one per table; two balance scales for demonstration; *Mighty Maddie*; collection of literature books per table

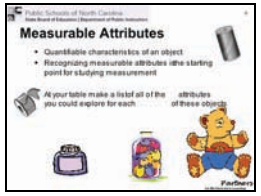
Slide	Tasks/Activity	Notes
	**(slide 1) Title: Kindergarten Module 5** This module focuses on measurement and the use of literature in developing mathematical concepts. Notice that, while there are only a couple of essential standards in measurement for kindergarten, the understanding of attributes (properties) crosses multiple strands – specifically data, geometry, as well as number and algebra.	
	**(slide 2) Attributes – Ways to Describe** Attributes are the basis of comparisons and classifications and are the foundation of the Dewey Decimal system and the science classification systems. Each of these objects has many attributes. We will be talking about those attributes as we work together in this module. (Do not stop to talk about attributes here. The pictures are repeated on slide 6.)	
	**(slide 3) What is Measurement?** Measurement is both a count of units and a process. Have a volunteer read points from the slide.	
	**(slide 4) What is Measurement?** Measurement activities can teach important everyday skills, strengthen students' knowledge of other important topics in mathematics and connect between other subject areas. Give participants 2 minutes to brainstorm and list at their tables ways students informally use measurement concepts or skills. Then ask each group to read 2 items off its list, not repeating examples. Go around the room as many times as necessary to get all items on the lists.	



(slide 5) Big Ideas in Elementary Mathematics; Essential Standards
Have participants discuss the correlation of the Big Ideas and the Kindergarten Essential Standards.

Points to highlight if they are not brought up by participants include:

- Kindergarten introduces the idea that an object can be described by several measurable attributes, specifically length and mass.
- Prior to identifying a specific number of units, kindergarteners work with direct comparison of objects that does not require a numerical value. Rather they focus on comparing and ordering objects as they develop comparative language.
- Comparing and ordering apply to all measurable attributes. Some work with nonstandard units for length and mass might also be done in kindergarten for those that are ready.

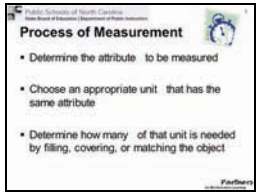
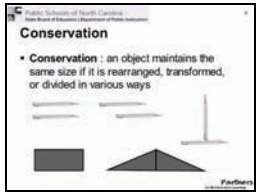


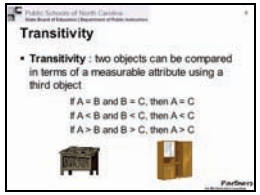
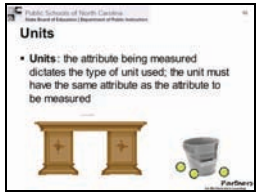
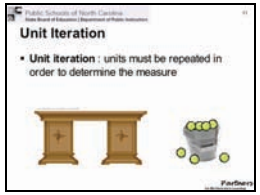
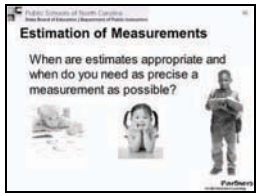
(slide 6) Measurable Attributes
Objects have many attributes such as texture, color, and size. Measurable attributes are quantifiable characteristics of an object. What measurable attributes might we explore for each of the objects shown on the slide? Make a list at your table. Have volunteers share attributes for each object.

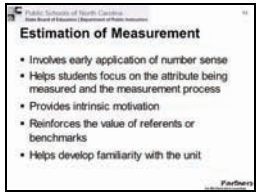
Young children begin exploring measurable attributes by looking at, touching, and comparing physical objects directly. If they pick up two boxes, they can begin to determine which is heavier than the other. If they pour juice into different cups, they experience if one will hold more than the other. If they line up two jump ropes side by side, they can see if one is longer or shorter than the other.

As they begin to develop understanding of measurement concepts, they should also develop vocabulary for describing the results of their explorations. Comparative language becomes part of a child's natural vocabulary based on experience. Ask participants to suggest comparative words that students could use related to the attributes they listed. (For example, longer, shorter, about the same, taller, shorter, heavier, lighter, cooler, warmer, faster and slower)

Experiences with directly comparing measurable attributes lead children into more formal measuring concepts. We will discuss the process of measurement and some of its components. The vocabulary presented is for adults and is not a requirement for children. Kindergarteners

	develop understandings of these concepts without having to call them by name.	
	**(slide 7) Process of Measurement** (This is content from last year so review it quickly.) The process of measurement is the same for all attributes. • First, the particular attribute to be measured must be determined. • Secondly, an appropriate unit having the same attribute is selected. Also, the size of the unit chosen should relate reasonably to the size of the object being measured. For example, if students were to measure the length of a classroom table, they might use straws which have length themselves and also would be a reasonable unit of length for matching the table length. Paperclips also have length but they might be too small a unit for students to handle table. • Finally, the selected unit is compared to the object and the amount needed (measure) is determined.	
	**(slide 8) Conservation** Teachers frequently think about conservation of number; it is an important idea related to measurement also. Ask a participant to read the definition on the slide. The pencils illustrate conservation of length. The length of the pencils does not change as they are rearranged. Another example of conservation of length would be the recognition that a piece of string that is stretched out maintains the same length when it is gathered up in a ball. Conservation of area is modeled with the blue rectangle which can be cut on the diagonal and rearranged into the triangle. The area remains the same although the shapes do not look the same. What are some examples illustrating conservation of weight? (ball of play dough and then rolling it out into a snake; a piece of aluminum foil and then crumbling it up into a ball) What are some examples illustrating conservation of capacity? (pouring from one pint container into different shaped container which also holds a pint)?	

	**(slide 9) Transitivity** An example of transitivity is comparing a desk in one room with a bookcase in another room to see if exchanging them would work for the particular available space. By marking a string the width of the desk and then taking the string to compare it with the bookcase, you can determine if the bookcase is the same, shorter or longer than the desk. In the equations shown on the slide, the string becomes the "B" as it is compared to "A" the desk and "C" the bookcase. Understanding the conservation of the string's length precedes the concept of transitivity. It is important to recognize that the string's length remains constant even when the string is balled up and moved from one place to another.	
	**(slide 10) Units** The chosen unit should have the same attribute as the attribute to be measured. Lengths are compared to units of length, area to units of area, weight to units of weight, etc. For example, a pencil to measure the length of the table would be appropriate and three dimensional tennis balls would be appropriate to measure the capacity of the bucket.	
	**(slide 11) Unit Iteration** Iteration or the repetition of units requires that the units line up, cover or fill in an organized way without gaps or overlaps.	
	**(slide 12) Estimation of Measurements** At their tables have participants discuss the question on the slide. When are estimates appropriate and when do you need as precise a measurement as possible? After a couple of minutes, have several volunteers share with the whole group.	



(slide 13) Estimation of Measurements

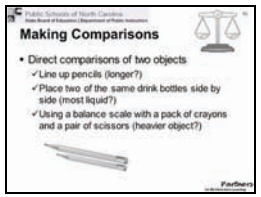
Estimation is important in measuring activities for several reasons. Share the following points from the slide.

- The estimate a student makes provides information about his number sense such as recognizing a large amount and calling it a number that seems big to him. Many estimation and counting opportunities help students refine number sense. This is true for both non-standard and standard measurements.
- A student must recognize the attribute to be measured and understand the process of measurement to give a meaningful estimate.
- Estimating can be fun and can encourage a competitive spirit, getting students to want to be better at estimating.
- When referents or benchmarks are provided, students come to see their importance in determining a better estimate. For example, if students are shown three pencil lengths across a table, then they can use that to help them in estimating the total length in pencils.
- When estimating, students must have a visual image of the unit before they can make a reasonable estimate.

(slide 14) Literature Connection

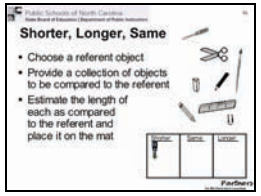
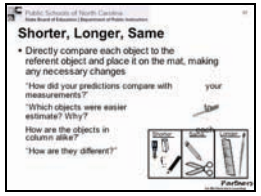
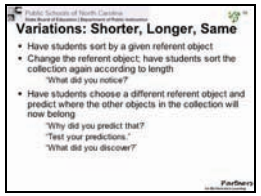
Read or paraphrase *The Best Bug Parade*. Have participants discuss activities to follow up the book.

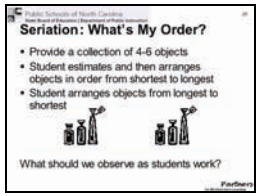
[Examples: 1) Children draw their own bugs, cut them out and line them up according to size, label each; 2) Children work in groups of 3-5 to line themselves up according to height, using comparative language to describe the line up; 3) Children (3 in a group) each throw a cotton ball and compare their distance with each other, using longest, shortest, longer, shorter to describe the relationships.]

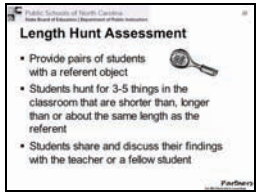


(slide 15) Making Comparisons

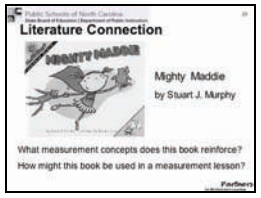
Children first begin measuring an attribute with direct comparison. When students are comparing lengths, teachers observe how they begin. Do students line up the objects at the same starting point? When students are comparing weights, do they begin with a balanced scale? All these skills need to be modeled and demonstrated for students.

	**(slide 16) Shorter, Longer, Same** Objects for this activity should be ones that focus on the attribute of length. As a classroom activity, the teacher provides one object as the referent, such as the toy screwdriver on the slide, and the students compare each of the other objects using the referent. This activity is slightly modified to engage the adult participants. Present an object emphasizing length (ex. a child's belt, a boot shoelace, a piece of ribbon or length of adding machine tape) as your referent. Have participants at a table number themselves 1-4. Ask participant # 1 from each group to compare the length of the adding machine tape at their table to the referent, estimating whether the tape is shorter than, about the same as, or longer than the referent. The estimating should be done while the presenter walks among the tables with the referent. Then the #1 participants place their strip of adding machine tape on the chart according to the estimates.	
	**(slide 17) Shorter, Longer, Same** Then one volunteer participant can take the referent object to the chart and directly compare it to the tapes, moving any that need to be in a different column. This direct comparison models what students will do as they focus on lining up objects at the same beginning point to get an accurate comparison. Notice the types of questions that require the students to think about what they have done.	
	**(slide 18) Shorter, Longer, Same** The next slides offer activities with linear measurement that can be done in a kindergarten classroom. Having students sort by a given referent object and then resort the same collection by a different referent object provides an initial opportunity for students to generalize about length and to experience the transitive property. As they explain what they noticed, comments such as "The pencil was about the same length as the screwdriver and the paintbrush was longer than the screwdriver so it is also longer than the pencil" might be shared. Ask: Why are questions such as these shown on the slide important? Discussion questions help students formulate their thoughts and findings. These same conversations help students develop	

	their vocabulary and justify their thoughts and also help teachers learn about students' understandings and misconceptions. Note the circling arrow symbol in the upper right corner indicating activities that can be done throughout the year with some modifications.	
	**(slide 19) Variations: Shorter, Taller, Same** What responses might you expect from kindergarten students to the questions on the slide? Why is it important for students to talk about their thinking and allow them to hear each others' ideas without the teacher always being the "final authority"?	
	**(slide 20) Seriation: What's My Order?** After students are able to compare two objects by specific attributes, then seriation can be introduced. Seriation is the ordering of more than two objects by a particular attribute. Since the attribute of length (height) is one of the first attributes children focus on, arranging a collection of objects in order from shortest to longest (tallest) or from longest (tallest) to shortest is a natural progression. The number of objects to be ordered should be based on the ability of the student, starting with 3-4 in a set and then adding more to the collection. Ask: What do we observe as students work? (how students begin task, do they estimate first, do they line objects up correctly in order to compare them, do they compare several at a time and move objects accordingly within the arrangement)	
	**(slide 21) Variation: What's My Order?** This is a variation for seriation as students work with length. Model this activity with the teddy bears. Participant #2 should bring each group's teddy bear to the front of the class and hold it in front of him/her. Have a volunteer estimate the sitting heights of the teddy bears and arrange the participants in order from shortest bear to tallest bear. Participants holding bears then sit the bears across a table and the order is then checked. Note to leaders: Be certain all teddy bears will "sit." Otherwise, have participants estimate the bears' standing height.	



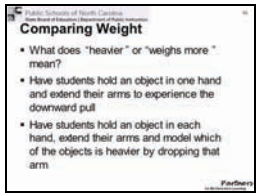
(slide 22) Length Hunt Assessment
This activity provides an opportunity for a student to search independently for items to compare. A student then explains and justifies his findings with a fellow student or teacher. This is a good assessment task.



(slide 23) Literature Connection
Discuss the definitions of weight and mass.
Weight is the measure of the pull or force of gravity on an object.
Mass is the amount of matter in an object and a measure of the force needed to move it.

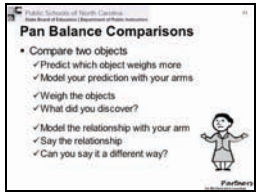
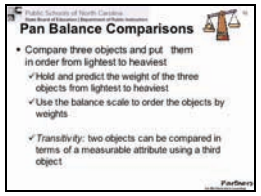
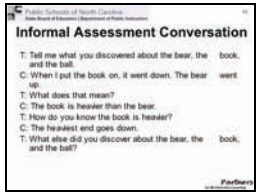
On earth, the measures of mass and weight are the same. On the moon where the pull of gravity is much less than on earth, an object's weight is less than its weight on earth but the mass remains the same on the moon and on earth. For primary students the term "weight" can be used as they explore how much something weighs and classify things as lighter or heavier.

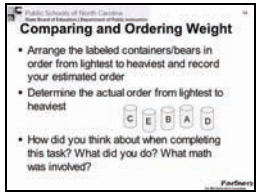
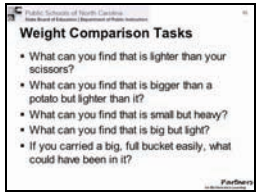
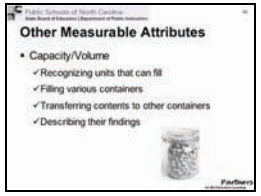
Read *Mighty Maddie*. What measurement concepts does this book reinforce? (comparisons of heavy or light, size does not necessarily relate to weight)
How might this book be used in a measurement lesson?

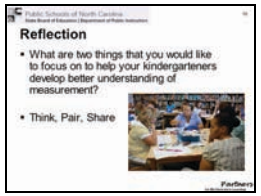
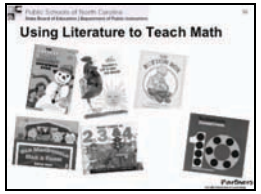
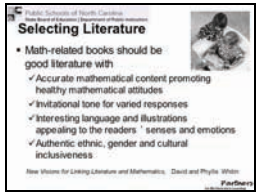


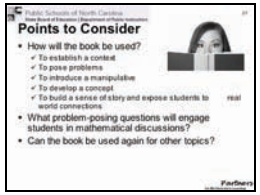
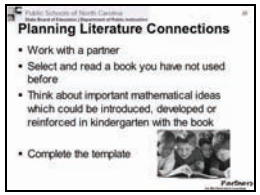
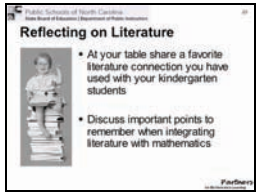
(slide 24) Comparing Weight
These activities help introduce the pan balance as students actually feel the weight pulling them down farther on one side.

Some students may think that all like objects have the same weight. To help correct this possible misunderstanding, have students lift a variety of like objects such as different books with varying weights. Another experiment to address this misunderstanding is to provide identical containers such as margarine tubs or film canisters, leaving one empty and filling others with varying numbers of blocks or amounts of sand.

	**(slide 25) Pan Balance Comparisons** In the classroom, students should hold an object in each hand and predict which one weighs more. Using their arms, they model their prediction by lowering the arm holding the estimated heavier object and raising the lighter one. Students then use a balance scale and discover which object is heavier. They then model the relationship with their arms and state the relationship as one object is heavier than the other or in reverse state that one object is lighter than the other. Ask: Why is it necessary for teachers and students to talk explicitly about the position of one's arms (and the balance arms) in relation to which object is heavier and which is lighter? What misconceptions do students often have?	
	**(slide 26) Pan Balance Comparisons** Adding a third object provides an opportunity for students to work with the transitive property and seriation as they compare two objects at a time through multiple comparisons and then recognize the relationship between all three objects. For example, if students had a small stuffed bear, a book and a ball to order from heaviest to lightest, they start by comparing two of the objects. If they discover that the book is heavier than the bear, then they must determine how the ball compares. They can compare the bear and the ball. If the bear is heavier than the ball, then they know the book is also heavier than the ball so they can order them correctly. This is an example of reasoning in kindergarten.	
	**(slide 27) Informal Assessment Conversation** This is a sample conversation between teacher and child after completing the task of ordering a small stuffed bear, a book and a ball by weight. The teacher asks questions that help the student focus on mathematical understandings from the task. What else might the teacher ask or do as a result of this conversation? (ex. Ask what they know about the ball; have student justify how they would order all three objects; have student select three other objects to arrange in order by weight)	

	**(slide 28) Comparing and Ordering Weight** Have participant #3 bring each group's teddy bear to one side of the room and participant # 4 to bring each group's labeled container to a different area of the room. Participants on each side of the room work together to estimate the order of their objects' weights from lightest to heaviest and record their estimates. Provide a balance scale for each group to use to determine the actual order. (Participants #1 and #2 from each table should choose one of the groups to observe.) When participants return to their tables, have volunteers share their thoughts and procedures and the math involved in the task (multiple comparisons).	
	**(slide 29) Weight Comparison Tasks** At each table have each numbered participant respond to the corresponding numbered task by jotting down their answers. Any participants beyond 4 at a table, address question 5. After several minutes, have a volunteer give answers for each question and explain how they thought about it. Ask: Why are tasks such as these important for students? These are open measurement task questions that allow students to think individually and make connections to their world. Children must focus on language, comparing by lifting, and the attributes of size and weight. It is important for the children to talk about what they did and justify it as they develop the language and concepts of measurement.	
	**(slide 30) Other Measurable Attributes** Kindergarten students explore capacity at sand or water tables or with materials such as rice or beans as they pour from one container to another. They come to recognize the attribute of capacity or how much something can hold.	

	**(slide 31) Other Explorations** Students explore covering the area of a figure through shapes that can be filled with one shape of pattern blocks. They experience covering a shape by flipping or rotating pieces. Covering a figure with all hexagons and then covering the same figure with blue parallelograms helps students focus on various size units.	
	**(slide 32) Reflection** Have participants think individually, talk with a partner, and then have several share their ideas with the group.	
	**(slide 33) Using Literature to Teach Math** The last part of the session will be making literature connections. Children enjoy hearing and reading stories. Making connections between language arts and mathematics can come naturally from these stories.	
	**(slide 34) Selecting Literature** Good childrens' literature engages and inspires and begs to be reread. The illustrations extend the text and draw in readers of all cultures and genders. According to David and Phyllis Whitin, authors of *New Visions for Linking Literature and Mathematics* 2004, when selecting math-related literature books the following criteria should be considered: • Mathematical content is accurate, reflects functional use in realistic contexts, encourages positive attitudes • The tone of the book is inviting rather than just telling information. • The language and illustrations appeal to the readers and their interests • The book is inclusive, without stereotyping	

	**(slide 35) Points to Consider** Once a book has been selected to accompany a mathematical topic, other points need to be considered in the planning stage. • How will the book be best used? • What questions will bring out stimulating discussion from the students. • What problem-posing questions will get them engaged in mathematical thinking? • What other topics might the book be used with later? It is valuable for the students to have access to the books themselves to sit and "read" over and over, encouraging their own imaginations, discussions, and questions.	
	**(slide 33) Planning Literature Connections** Provide each group with 5-8 literature books. Participants work in pairs as they select a book to read and analyze. They are to think about mathematical understandings that could be introduced, developed or reinforced in first grade and how they would present them. They are to fill in their plans on the Literature Connection Template. Allow 20-30 minutes for this activity depending on time available.	
	**(slide 34) Reflecting on Literature** Have participants talk at their tables as they discuss the two points listed on the slide.	
	(slides 38-41) Credit slides	