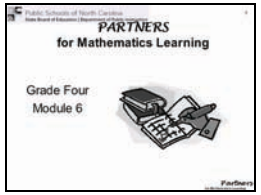
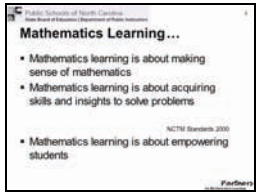
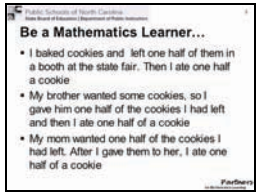
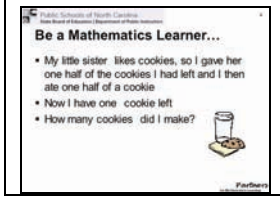
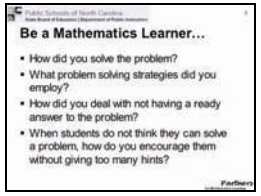
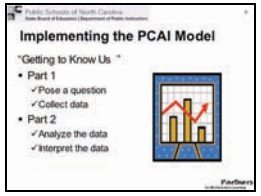
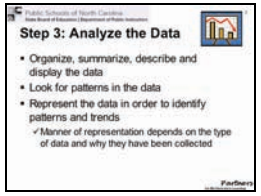
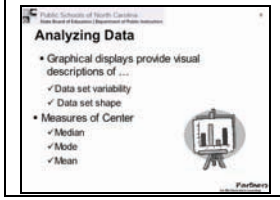
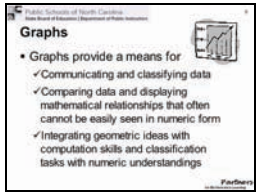
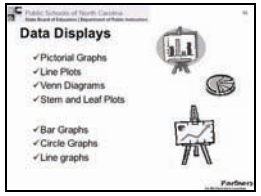
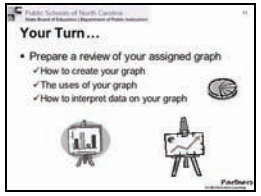
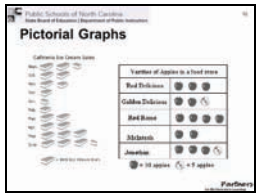
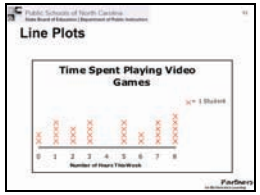
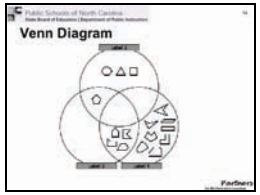
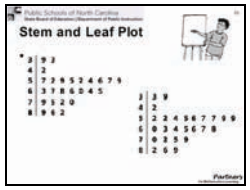
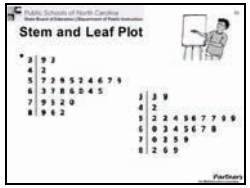
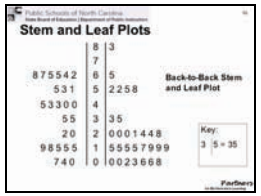
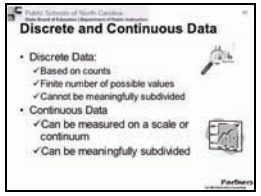
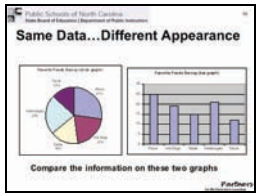
General Materials and Supplies:
Set of 30 interlocking cubes per group
Paper, markers, crayons, rulers for making graphs

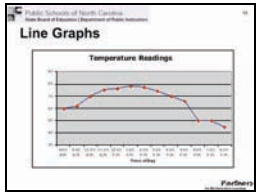
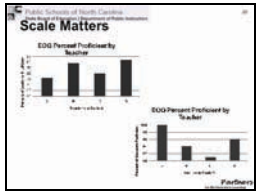
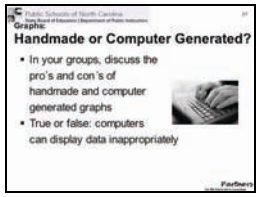
Tasks/Activity	Personal Notes	Tasks/Activity
	(Slide 1) **Grade 4 Module 6** Greet participants. Begin by having groups share how things went for them. Keep this brief, since they will include information in their presentation. Have brief discussion of suggestions for doing this with children. For example, they may want to consider pairing up classroom groups for a "trial run" of their question and data collection procedure.	
	(Slide 2) **Mathematics Learning…** Add to the NCTM goals the goal of empowering students – to solve problems, take risks in attempting to solve problems, learn to be comfortable with not having a ready answer because they know they can find ways to figure it out. Tell participants they are to be the empowered students as they try to solve a problem without a ready answer.	
	(Slide 3) **Be a Mathematics Learner** Read these bullets to the group, then go to the next slide for the rest of the problem.	
	(Slide 4) **Be a Mathematics Learner** Read these bullets. Then give participants time to work together to come up with a solution. Go to the next slide to discuss their solutions.	

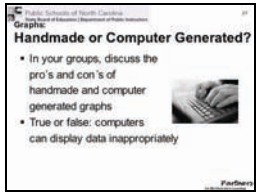
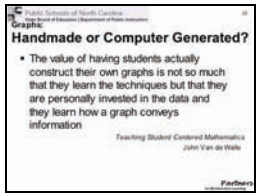
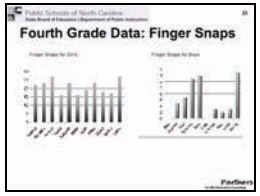
	(Slide 5) **Be a Mathematics Learner** Have participants share their solutions and strategies. Did someone notice that for each new situation, there had to be an odd number of cookies? Did someone use a diagram or picture? Did someone "play with" the numbers? Did someone work backwards from the one cookie left? What other strategies were employed? (The solution is 31 cookies.) Then have them reflect on which problem solving strategies they employed. Talk about the importance of encountering problems for which you do not have an immediate solution or solution strategy. "Not knowing" should not be a scary situation for us or our students, but an opportunity to explore, reason, learn, and expand our thinking skills and problem solving ability. Do we need first to get over the need to "know" so that we can help our students be comfortable with "not knowing"?	
	(Slide 6) **Implementing the PCAI Model: Getting to Know Us** Provide a big picture of this session's work on data: We will review data analysis and interpretation and then will analyze and interpret their data in order to make a presentation to the class.	
	(Slide 7) **Step 3: Analyzing the Data** Briefly review the information on the slide. Note this is multi-step, the pieces of the third step in the model. Ask participants what things they might consider when choosing a display for data. (Do they want to show parts of a whole, change over time, their audience, etc.)	
	(Slide 8) **Analyzing Data** Explain to participants that graphs provide visual means to represent and analyze data. Data set variability refers to how the data is dispersed. It includes the range (difference between the minimum and maximum data points), which tells about the spread of the data. Graphs also are a means to analyze data in terms of its shape.	

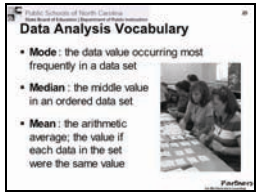
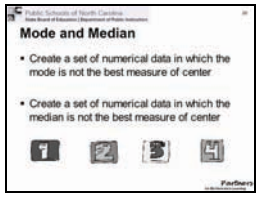
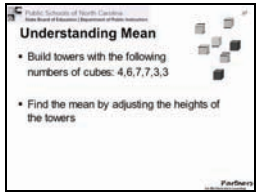
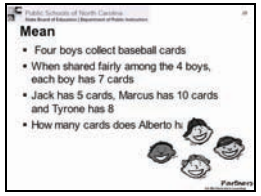
	Ask what things might they notice about the shape of their data. (Clumps, gaps, trends, unusual data points) Explain that each of these three measures of center or measures of central tendency will be addressed later in this module. Stress that these 3 are one way to describe what is typical in a set of data and that different situations may call for one over the others to be used as a "measure of center".	
	(Slide 9) **Graphs** Review the information on the slide.	
	(Slide 10) **Data Displays** Review the different types of data displays offered on the slide. Ask participants to explain what each type of graph is along with types of data they best represent. (Answers may vary.) Note for participants: Originally stem and leaf plots were in the 2009 essential standards. In May they were moved out of grade 4. Check the final expectations when the State Board officially adopts the curriculum. We have left this in the professional development because students see them in many contexts and they are a fast and easy way to organize data.	
	(Slide 11) **Your Turn…** Divide the participants into 4 groups. Assign them one of the first 4 graph types. (Pictorial, line plot, Venn, stem and leaf plot.) The leader will present bar graphs, circle graphs and line graphs. Have each group prepare a brief review of their assigned representation and present it to the class. Their review should include how to create the graph, its uses, and how to interpret the characteristics of the data represented by the graph. Briefly scroll through the next 5 slides to show the slides that will be visible as they present. (There are 2 slides for stem and leaf). Each group may use one of the next 5 slides as they present. They may use their slide notes (Module 6, Handout 1- 2 pages) to view the slides as they	

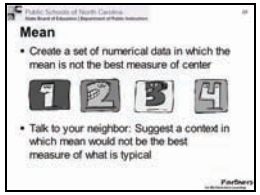
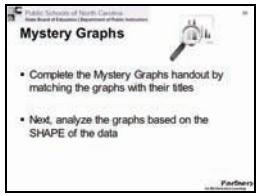
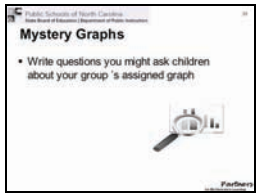
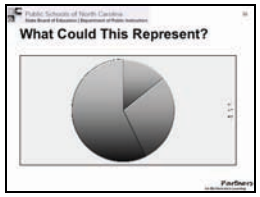
	work. The next 5 slides are used as a visual representation of each type to be shown as groups present.	
	(Slide 12) **Pictorial Graphs** Show this slide as group presents pictorial graphs. Points that should be brought out include: Pictorial graphs use pictures to depict quantities; pictures must be same size and shape; legends or keys may be used; caution needed when using fractional parts of a picture; used with discrete* data; transitions nicely to line plots. *Discrete data: information can be categorized into a classification and is based on counts. There are only a finite number of values possible. The values cannot be meaningfully subdivided.	
	(Slide 13) **Line Plots** Show as group presents line plot information. Line plots have the data values displayed along a number line with X's or other symbols above the number line that represent the frequency for that data value. X's or other symbols must be same size and all data points are visible. (If categories are used along a line, it is not a line plot.)	
	(Slide 14) **Venn Diagram** Show as group presents Venn information. Venn diagram is considered a graphic organizer for comparing similarities and differences.	
	(Slide 15) **Stem and Leaf Plot** Show as group presents stem and leaf plots. Key points to bring out: Stem and Leaf Plots are characterized by the separation of digits in numeric form • Fast and easy way to organize data • Frequently separates the 10s and ones into columns; often a first step in grouping data. • Can be displayed ordered or unordered. While children should order data to quickly see highest and lowest values to find the range and to find the mode, they may see stem and leaf plots in which the data are left unordered. They need to check to see if data are ordered or not before addressing range and mode.	

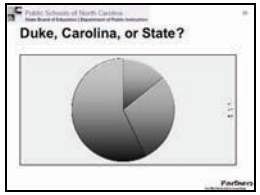
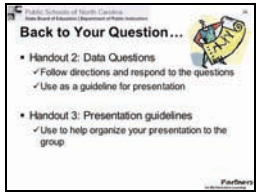
	(Slide 15) **Stem and Leaf Plot** Show as group presents stem and leaf plots. Key points to bring out: Stem and Leaf Plots are characterized by the separation of digits in numeric form • Fast and easy way to organize data • Frequently separates the 10s and ones into columns; often a first step in grouping data. • Can be displayed ordered or unordered. While children should order data to quickly see highest and lowest values to find the range and to find the mode, they may see stem and leaf plots in which the data are left unordered. They need to check to see if data are ordered or not before addressing range and mode. • Data points can be in ascending or descending order.	
	(Slide 16) **Stem and Leaf Plots** As this slide is shown make sure that participants know how to read a back-to-back stem and leaf.	
	(Slide 17) **Discrete and Continuous Data** Discrete data: information can be categorized into a classification and is based on counts. There are only a finite number of values possible (shoe size). The values cannot be meaningfully subdivided. Continuous data are pieces of information that can be measured on a scale or continuum. Continuous data can take any numeric value and can be meaningfully subdivided into finer and finer increments depending on the precision of the measurement tool (hair length).	
	(Slide 18) **Same Data…Different Appearance** Briefly review Bar graphs have horizontal or vertical bars of the same width with spaces between the bars; used with discrete data; Show part-to-part relationships; spaces needed between bars. Circle graphs have data in categories and show part to whole relationships; Ask participants how student can make circle graphs that are accurate representations of data. (Can be made by	

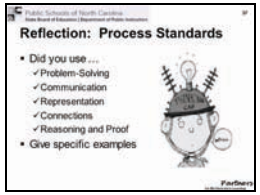
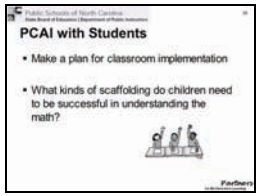
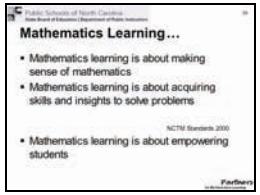
	(Slide 19) **Line Graphs** Review that line graphs show continuous data changing over time, while those previously presented show discrete data. . They may indicate trends. For example, daily temperature data collected over several weeks can be used to indicate a change in season. Line graphs are frequently misused. Stress that every point on the line can be interpreted. In the classroom, class pet weight, time for ice to melt, average weights of children at differing ages could be displayed on line graphs. CAUTION: Be careful that we do not convey that the connector lines in a line graph convey continuous pattern of change. In between the discrete points in a line graph, the true change could do anything—not just the line direction to the next point. Between 12 PM and 1 PM, it could have dropped a few degrees and then rose when the sun came out of the clouds. We've all experienced this at the pool in early summer, when at 2 PM, it is very hot, but then storm clouds come over quickly and it is very cold. Then clouds pass, the sun comes out, and the temperature is even higher at 3 PM.	
	(Slide 20) **Scale Matters** Have participants look at the two graphs on the screen. Be sure to read the labels if participants have a hard time seeing them. Explain that the letters along the horizontal axis represent teachers. Ask which grade level did better. Which teacher has the lowest scores in the 2 grades? If no one noticed, point out the scale on each graph. Why is there a need for the same scale to be used if you are going to compare data from different samples? Mention the use of scale to skew data. (These data were actually presented this way at a faculty meeting in North Carolina to show EOG results in grades 4 and 5.)	
	(Slide 21) **Handmade or Computer Generated?** Have participants respond to the questions on the slide and share. Note that we do not want to get overly anxious about perfect hand-made graph construction; rather the focus should be on communicating a message about collected data. Technology is an option and provides a means to construct several different kinds of graphs with the same data quickly and efficiently. However, children must have the background knowledge to wisely select appropriate representations for their data. Computers will graph whatever you tell them to. Meaning they will graph discrete data in line graphs or create whatever graph you choose with whatever data you input. Computers	

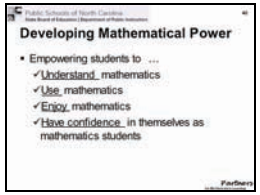
	(Slide 21) **Handmade or Computer Generated?** Have participants respond to the questions on the slide and share. Note that we do not want to get overly anxious about perfect hand-made graph construction; rather the focus should be on communicating a message about collected data. Technology is an option and provides a means to construct several different kinds of graphs with the same data quickly and efficiently. However, children must have the background knowledge to wisely select appropriate representations for their data. Computers will graph whatever you tell them to. Meaning they will graph discrete data in line graphs or create whatever graph you choose with whatever data you input. Computers also make their own decisions about scale (have a standard setting) that you may or may not want.	
	(Slide 22) **Graphs: Handmade or Computer Generated?** Have participants respond to the quote on the screen. How often do they utilize computer-generated graphs as teaching tools? How often do they instruct students in creating computer-generated graphs?	
	(Slide 23) **Fourth Grade Data: Finger Snaps** Explain that this slide shows data collected by fourth graders. Their task was to answer the question, "What is a typical fourth grade boy and fourth grade girl in Mrs. Brock's Class?" They were to write a question and then collect the same data, (in this case the number of finger snaps in 10 seconds) from boys and girls and compare the data from the 2 samples. A pair of students used a computer to make the 2 graphs on the slide. Ask participants what they notice. (Axes are not labeled. A bar graph showing individual student results does not allow the students to compare the 2 samples. The scale selected by the computer varies from graph to graph.) Ask participants how they might handle this. (Ex. Ask questions like, "According to your graphs, are there differences between boys' and girls' finger snaps? What if you chose a different representation for your data? What might make the differences between boys and girls more obvious?) Stress that this demonstrates the importance of students going through all parts of the PCAI	

	(Slide 25) **Data Analysis Vocabulary** Ask a volunteer to read the terms given on the slide. Note that all three measures of central tendency may be used to describe what is typical within a data set.	
	(Slide 26) **Mode and Median** Tell participants to work in groups to quickly prepare data for each bullet. Example for first bullet: Imagine packing for a trip and reading that the mode for the temperature was 50 degrees over a 12 day period. However the actual temperatures were 50, 50,90, 97,96,89, 94, 99, 95, 93, 98, 92 Example for second bullet: Imagine your parents being told only the median of 57 for your grades in math and your grades were 56,57, 57,99,99.	
	(Slide 27) **Understanding Mean** Remind participants that determining the mean should not be taught as an algorithm. Children need to understand it as a balancing point or an "evening out" of the data or a "fair share". Have the participants quickly do the activity on the slide as a review from last year. Review that this reinforces what the mean is rather than teaching a procedure. Using the evening out method, 2 from each of the towers with 7 could be moved to the towers of 3 and one from the tower of 6 could be moved to the tower of 4. This would result in 6 towers of 5.	
	(Slide 28) **Mean** Ask participants to determine the answer to the problem using cubes. Push them to find more than one way. Possible solutions: Make 4 towers with 7 cubes each. Then move the cubes to make towers of 5,10,and 8. The remaining cubes belong to Alberto. Another is to make the three given towers. It helps to use cubes of the same color to make these towers. Then begin to even out the towers to make towers of 7 by taking 2 from Marcus and giving them to Jack. Then take 1 from Tyrone and 1 from Marcus and give it to Alberto. Add 5 cubes of a different color to Alberto's pile to make it a pile of 7. This will visually show how many Alberto had.	

	(Slide 29) **Mean** Have groups complete the task on the slide and share. Ex.) Mean cost of housing in a development where most houses are $300,000-$350,000 but the developer builds a $1,000,000 house. You may want to share this actual event described *in Math Matters.* In the late 1990s the mean annual salary of geology majors at UNC was over $500,00.00!!! Before you run out to apply to get a geology degree….Michael Jordan was a geology major and at the time the mean salary was determined his annual salary was over 50 million dollars.	
	(Slide 30) **Mystery Graphs** Direct participants to the handout entitled Mystery Graphs (Handout 2). Review the tasks on the slide, reminding them that the shape of the data-- clusters, clumps, gaps, and outliers–-provides valuable information for analysis. Ask them to work in groups to complete the matching and then to analyze each graph based on the data's shape. Have them share their matching responses and how they arrived at their answers. Stress the importance of children explaining how they arrive at responses. Then have groups share analysis based on shape of the data.	
	(Slide 31) **Mystery Graphs** Assign a graph to each group and ask them to generate questions they might ask children about the data on the assigned graph. (Ex. Based on the data in graph 2, if a new child moved to our school, about how tall do you think s/he would be? Why? What is the mode for the data? What is the median? What is the mean? Which of the 3 measures of center best describes a typical fifth grader?) Have the smaller groups ask some of their questions to the whole group	
	(Slide 32) **What Data Could this Represent?** Ask groups to brainstorm a list of what this graph might represent. (Preferred Team: Duke, Carolina or State…favorite ice cream: vanilla, mint chip, chocolate; Times you saw a Harry Potter movie: 0,once, more than once, etc.) Ask what they notice about the size of each part in relationship to the whole and to each other.	

	(Slide 33) **Duke, Carolina, or State?** Suppose the question was: Which do you like best: Duke, Carolina, or State? Ask the participants to examine the graph and tell what the values of each of the sections might be as a fraction of the whole. Then ask them how that could be used to determine the number of people in each category if they knew that 50 people were polled. Have participants share possible values that each colored section of the graph might represent. Make sure the answers are proportionally correct…ie the black could not be 110, the red 55 and the blue 85 because together the red and blue are smaller than the black on the graph.	
	(Slide 34) **Back to Your Question…** At this point determine how much time is left in order to provide participants with an amount of time for working in their groups and preparing their presentations. Explain that the groups will have _____ minutes to complete the handouts (Handouts 2 and 3) in their materials. The first handout has questions they are to answer. The second will serve as a guide for their presentation to the group. As they work, circulate and provide support.	
	(Slide 35) **It's Show Time…** Briefly explain the difference between what fourth and fifth grade did, if you were working with a mixed group. (Grade 4 had to represent the data from 2 groups on the same type of graph. Grade 5 had to represent each set of data on 2 different graphs for a total of 4 graphs in order to compare different representations.) Have each group present their information, beginning with their question. When all groups have finished, debrief the process. Ask what we have learned about our group based on our questions and data.	

	(Slide 36) **Integration of Strands** Encourage participants to make connections to other strands/objectives. Note that frequently teachers do not feel they have time to do an investigation like this. Point out that it provides purposeful computation from the number strand. Have them tell specific computation problems they did and point out this was practice with a purpose as opposed to a worksheet of practice. This kind of investigation ties nicely with measurement. For example, what is the height of a typical fourth grade girl/boy? See next slide for process standards.	
	(Slide 37) **Reflection: Process Standards** Divide the participants into 5 groups. Assign one of the Process Standards to each group. Have the groups find examples of each one in the statistics work they have done and then have each small group share with the whole group. (Communication as they worked in groups, wrote questions, asked others their question, presented to class, etc)	
	(Slide 38) **PCAI with Students** Ask participants to discuss ideas related to each bullet at their tables. Share ideas if time allows. Plans should include timeframe, provisions for direct instruction. Make sure participants understand that this will be a somewhat loose plan, needing modification to fit the needs of the children. Reiterate that mini lessons on topics such as median and mode will be needed.	
	(Slide 39) **Mathematics Learning…** Reiterate the this goal of empowering students – to solve problems, take risks in attempting to solve problems, learn to be comfortable with not having a ready answer because they know they can find ways to figure it out. Tell participants they are to be the empowered students as they try to solve a problem without a ready answer.	

	(Slide 40) **Developing Mathematical Power** We want North Carolina's students to be empowered to understand mathematics, to be able to use mathematics to solve problems, to enjoy mathematics rather than being intimidated or bored by it, and to have confidence in themselves as young mathematicians.	
	(Slide 41-44) **Closing and credit slides**	