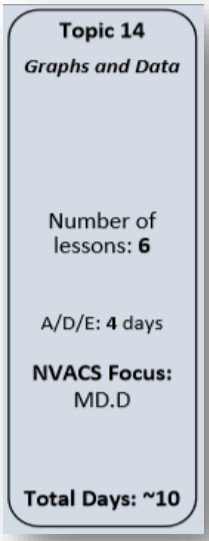
Grade 2 Topic 14: Graphs and Data



Big Conceptual Idea: K-5 Progression on Measurement and Data (Data Part) (pp. 6-7, 9-10)
Prior to instruction, view the Topic 14 Professional Development Video located in Pearson Realize online. Read the Teacher's Edition (TE): Cluster Overview/Math Background pages (pp. 799A-799E), the Topic Planner (pp.799I-799J), the Topic Performance Assessments (pp. 849-850A), and all 6 lessons.

Mathematical Background: Read Cluster Overview (TE, pp. 799A-799E)	Topic Essential Question: How can line plots, bar graphs, and picture graphs be used to show data and answer questions? *Reference Answering the Topic Essential Question (TE, pp. 845-846) for key elements of answers to the Essential Question.*

The lesson map for this topic is as follows:

14-1	14-2	14-3	14-4	14-5	14-6	Assessment

4 A/D/E days used strategically throughout the topic.

2nd Grade Curriculum Pacing Framework: Balanced Calendar

Instructional note:
The big idea of Topic 14 focuses on collecting and analyzing data that can be used to answer questions. Where do you see graphs and hear about data in your daily world? Maybe you've heard statistics about the weather and predicted water levels on the morning news, or perhaps the latest pharmaceutical commercial cited statistics from a recent study. Have you ever engaged in a conversation about home prices with your neighbors? Statistical literacy helps us make sense of the world around us, engage as citizens and question information that bombards us constantly. Development of numerical literacy begins as children. . Focus instruction on Nevada Academic Content Standards (NVACS, 2010) cluster 2.MD.D.

2.MD.D Represent and interpret data.

9. Generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object. Show the measurements by making a line plot, where the horizontal scale is marked off in whole-number units.

10. Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.

As identified in the NVACS, second grade students represent and interpret both categorical (2.MD.D.10) and measurement data (2.MD.D.9). These skills enable our students to think critically about statistics and graphs presented to them through print and digital media. Although Topic 14: Graphs and Data is labeled as a "Supporting Cluster", we must consider the real-life implications this learning will have on our students and its importance in their learning trajectory.

The NVAC K-5 data standards are comprised of work with two forms of data: *categorical data* and *measurement data*.

Categorical Data. In second grade, categorical data reflects data that is sorted into categories, such as birthdays by season, and is presented in picture graphs and bar graphs (reference lesson 14-3, 14-4 and 14-5). As stated in the Progression Documents, work with categorical data in the primary grades "will support their later work with bivariate categorical data and two-way tables in eighth grade." (CCSWT, 2011, p.2). The progression also identifies notable connections including the content of Topic 7, word problems involving addition and subtraction in *Put Together, Take Apart* and *Compare* situations as identified in Table 1 below (CCSWT, 2011, p.4).

Measurement Data. Measurement data refers to data collected through taking measurements. In second grade, this includes students measuring the length of their shoes and representing the data on a line plot (reference lesson 14-1 and 14-2). This work builds upon length measurement concepts in Topic 12. The Progression Documents also identify notable connections between measurement data and the focus of Topic 13, use of the number line diagram to add and subtract lengths within 100 as shown in Table 1 below (CCSWT, 2011, p.4).

Table 1: Some notable connections to K–5 data work

Grade	Standard	Notable Connections
	Categorical data	
2	2.MD.10. Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.	• 2.OA. Problems involving addition and subtraction ○ put-together, take-apart, compare
	Measurement data	
2	2.MD.9. Generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object. Show the measurements by making a line plot, where the horizontal scale is marked off in whole-number units.	• 1.MD.2. Length measurement • 2.MD.6. Number line

Common Core Standards Writing Team. (2011, June 20). *Progressions for the Common Core State Standards in Mathematics (draft). K-3 Categorical Data; Grades 2-5, Measurement Data.* Tucson, AZ: Institute for Mathematics and Education, University of Arizona.

The process of doing statistics focuses on numbers in context, called data, and includes formulating questions, collecting data, analyzing data and interpreting results. In statistics, the context is important, as it gives numbers meaning (CCSWT, 2011, p.3). The full process is needed for meaningful engagement. As you plan for Topic 14, look for extension opportunities that align to this process.

Step 1: Formulate Questions
Clarify the problem at hand.
Formulate one (or more) questions that can be answered with data.
Step 2: Collect Data
Design a plan to collect appropriate data.
Employ the plan to collect the data.
Step 3: Analyze Data
Select appropriate graphical and numerical methods.
Use these methods to analyze the data.
Step 4: Interpret Results
Interpret the analysis.
Relate the interpretation to the original question.

Source: Franklin, C.A., Kader, G., Mewborn, D., Moreno, J., Peck, R., Perry, M., & Scheaffer, R. (2005). Guidelines for Assessment and Instruction in Statistics Education: A Pre-K-12 Curriculum Framework. Alexandria, VA: American Statistical Association.

When working with data and graphs our questions may be mathematical or statistical in nature. Let's consider two examples, listed below, presented in *Teaching Student-Centered Mathematics*. Which question is mathematical in nature and which is statistical in nature?

1. *The average weight of 50 prize-winning tomatoes is 2.36 pounds. What is the combined weight, in pounds, of these 50 tomatoes? (NAEP sample question)*
2. *Table 17.1 gives the times each girl has recorded for seven trials of the 100-meter dash this year. Only one girl may compete in the upcoming track meet. Which girl would you select for the meet and why? (Van de Walle, 2014, p. 334)*

As you navigate through Topic 14, look for opportunities to extend questioning to attend to the statistical nature of the data as seen in example 2 above.

Math Practice 2: Reason abstractly and quantitatively

Focus on opportunities for students to develop MP.2 behaviors. This is the focus of the Math Practices and Problem Solving lesson 14-6. Reference Teacher's Edition (pp.F24-F24A) and the *Nevada Academic Content Standards for Mathematical Practice*.

Note: The purpose of the curriculum guides is for additional considerations. Therefore, not all components may have additional notes included in this guide.

Essential Academic Vocabulary Use these words consistently during instruction.	
New Academic Vocabulary: (First time explicitly taught)	Review Academic Vocabulary: (Vocabulary explicitly taught in prior grades or topics)
line plot symbol	*data* *bar graph* *picture graph*

Additional terminology that students may need support with: *formulate questions, collect data, analyze data, interpret results*

*Collaborative Team Conversations (CTC)

Consider using *one* of the following as part of the formative assessment process at the lesson level to **collect student work** to analyze for evidence of mathematical understanding:

Guiding question: "Are students applying their understanding that data can be represented visually by creating picture graphs?"

Lesson	Evidence	Look for
14-6	*Solve & Share* (student work samples)	Focus CTC around the big idea: • student strategies and models • picture graphs can be used to write and solve problems • use 1 symbol to represent different items
14-5	*Quick Check* (digital platform)	Focus CTC around data analysis and collection of student workspace (scratch paper). Printable version available under "Teacher Resources".

Learning Cycle Assessments (summative)	*Topic Assessments* SE pp. 845-850	Use *Scoring Guide* TE pp. 845-850

Standards listed in **bold** indicate a focus of the lesson.

NVACS (Content and Practices)	Mathematical Development of the Big Idea	Instructional Clarifications & Considerations
Lesson 14-1: Line Plots		
2.MD.D.9 2.MD.A.1 MP.2 MP.4 MP.5 MP.6	Access Prior Learning: In Topic 12, second grade students focused on the big idea of measurement in length. Developing the Big Idea: In this lesson, students are *developing* understanding that measurement data can be collected and displayed in a line plot. Students will collect and represent data of up to four length measurements.	Line plots are used to represent numerical data along a number line. Students draw a number line and mark each data point with a dot above the corresponding value. One benefit of line plots is that each data point is visible (Van de Walle et al., 2014, p.348). Reference Teaching Tool 46 (*Teacher's Resource Masters, Volume 2)* for a blank table and line plot. Topic Opener: Consider limiting the *Topic Opener* to discussion of the *Topic Essential Question* (TE, p. 799), *Review What You Know* (TE, pp. 800-802), and Topic 14 Vocabulary Words Activity (TE, p.800-802) for the words *data* and *line plot* only. Introduce remaining vocabulary words as they appear in instruction. Post the essential question and student strategies on your math focus wall. Solve & Share: During problem solving, child-watch for students who are able to estimate 9 inches, when selecting objects smaller than 9 inches to measure. In addition, child-watch for student understanding of measurement concepts learned in Topic 12. Reference the note below regarding estimation in measurement. Estimation in measurement is often needed in real-world applications. To build students' estimation competencies, the Progression Documents indicate that "research suggests explicit teaching of estimation strategies (such as iteration of a mental image of the unit or comparison with a known measurement) and prompting students to learn reference or benchmark lengths (e.g., an inch-long piece of gum, a 6-inch dollar bill), order points along a continuum, and build up mental rulers." (CCSWT, 2012, p.15). Visual Learning: During the animation, ask questions to extend students in *Step 1: Formulate Questions* (see statistical process in the Instructional Note at the beginning of this document). For example, you might explain that data is collected to answer questions. Then ask, "What question(s) do you have that could be answered by measuring objects and organizing data in a table like this one?" *-continues on next page-*

		Independent Practice/Math Practices and Problem Solving: As previously indicated, students do NOT need to do all of the problems in their Student Edition. However, ALL students NEED to have opportunities to solve problems at varying DOK levels. The *Independent Practice* page offers problems that support procedural skill and fluency. The *Math Practices and Problem Solving* page offers problems that support application. The *Quick Check* items (marked with a pink check) offer both opportunities. Have students complete these items first and continue on to other items as appropriate.
Lesson 14-2: More Line Plots		
2.MD.D.9 2.MD.A.1 MP.2 MP.4 MP.5 MP.6	Access Prior Learning: In the prior lesson, second grade students collected and represented up to four length-measurement data points on a line plot. Developing the Big Idea: In this lesson, students are *developing* understanding that measurement data can be collected and displayed in a line plot. Students will collect and represent *more* than four length-measurement data points.	This lesson offers students an opportunity to "see themselves" in the data by measuring the length of their shoe. This personal context brings meaning to the abstract nature of the line plot (Van de Walle et al., 2014, p. 348). Extending *Step 1: Formulate Questions* Just as in the real world, we want students to collect data with the purpose of answering a question. When students formulate their own questions, it adds meaning to the learning experience. As such, begin lesson 14-2 by having students generate questions they have about each other. This will help them them connect their questions to the data collection in the *Solve & Share*, thus extending step 1 of the statistical process. Solve and Share: * Record class show lengths on the board using a data table, similar to that shown in *Analyze Student Work* (TE, p.809). During problem solving, child-watch for students who only plot one dot for each numerical value. Encourage these students to think about the context of the problem and reflect on whether or not it makes sense to have fewer dots on the line plot than students in the class. Ask, *"How can our class data table help you check your line plot for accuracy?"* Labeling the data points and/or crossing off data in the table, may be helpful for some students. Extending *Step 3: Analyze Data* Although the text provides a line plot for the shoe data, engage students in a discussion around the selection of a graphical method (line plot, bar graph, picture graph, etc.) and its appropriateness for analyzing the data to answer the question formulated in "Extending *Step 1: Formulate Questions*" above. Ask students why the use of a line plot and categorization by shoe length is more helpful than a bar diagram with categories that represent each student. This discussion can also lead to greater depth when students engage in *Step 4: Interpret Results.* Conclude the share by asking students to interpret the line plot by asking, "What do you notice? What does the data tell you?" Assess and Differentiate: Rather than using the *Intervention* and *On-Level and Advanced* Activities, consider engaging students in the statistical process by generating their own questions, collecting data and representing it on a line plot (Teaching Tool 46). An example of a student question may be, "How many minutes do second graders in our class read each night?" Students should then analyze the data in their line plot by writing an "I notice…" sentence. Finally, have students interpret the data by answering their original question.
Lesson 14-3: Bar Graphs		
2.MD.D.10 MP.1 MP.2 MP.4	Access Prior Learning: In first grade (1.MD.C.4), students organized, represented and interpreted data with up to three categories using picture graphs and bar graphs. Students also compared how many more or less in each category. Developing the Big Idea: In this lesson, students are *developing* understanding of bar graphs for representing and analyzing data. The height of the bars make comparing data easier.	Bar graphs make the largest and smallest categories clearly visible. They also provide data that lends itself to *Put Together, Take Apart* and *Compare* word problems (NVACS, 2010, p. 88). To extend students, use the data in the lesson to write word problems for students to solve that involve these three problem types. If students have difficulty reading bar graphs, consider modifying the graph to make the parts countable. This can be done by using sticky notes to construct the bars of the graph, so students can count the sticky notes. After offering this support, return to full rectangular bars (Van de Walle, 2014, p.345-346). Solve & Share: In addition to what is asked, extend *Step 1*: *Formulate Questions* of the statistical process by asking students to generate a question that could be asked and answered with the "Birthdays by Season" data provided. *Step 3: Analyze Data* and *Step 4: Interpret Results* can also be supported by asking students to write something they notice about the data and connect it back to answer their question. *-continues on next page-*

		Visual Learning: As suggested in the Coherence note (TE, p.816), engage students in discussion that compares and contrasts bar graphs and line plots. Assess and Differentiate: Rather than doing the *On-Level* and *Advanced Activity Centers*, "Center Games" (TE, p.819A), engage all students in the statistical process (see the Instructional Note at the beginning of this document) so that they can "see themselves" in the data. Reference the *Intervention Activity*, "Getting to School" (TE, p.819A) for one such example, but allow students to ask their own question(s) and collect their own data. Teaching Tools 47 and 48 offer blank data tables and bar graphs.
Lesson 14-4: Picture Graphs		
2.MD.D.10 MP.2 MP.3 MP.4 MP.8	Access Prior Learning: In first grade (1.MD.C.4), students organized, represented and interpreted data with up to three categories using picture graphs and bar graphs. Students also compared how many more or less in each category. Developing the Big Idea: In this lesson, students are *developing* understanding of picture graphs for representing and analyzing data. The use of single symbols to represent data makes comparing data easier.	Picture graphs, also called pictographs, use single symbols to represent data. These symbols can represent *one* or a designated quantity. They also provide opportunities to practice skip counting and make connections to early multiplication (Van de Walle et al., 2014, p.344). In third grade, students will work with data sets that have multiple categories and represent that data with scaled picture graphs, where each symbol represents more than one piece of data. *Teaching Tool 49* offers a blank tally chart and picture graph. A note of CAUTION: Students may need support with how to draw symbols that all look the same and are aligned, so that data is more accurately represented and easily compared. Solve & Share: In addition to what is asked, extend *Step 3: Analyze Data* and *Step 4: Interpret Results* by asking students to write an "I notice… which is evidence of [or means]…" statement about the data. If your students do not demonstrate understanding of data, as illustrated in Ehrin's Work found in *Analyze Student Work* (TE, 821), select a student to share and use class discussion to clarify the meaning of data. If you do not see this misunderstanding in your classroom, do not introduce it. Assess and Differentiate: Rather than doing the *On-Level* and *Advanced Activity Centers*, "Center Games" (TE, p.825A), engage all students in the statistical process (see the Instructional Note at the beginning of this document) so that they can "see themselves" in the data. Reference the *Intervention Activity*, "Let's Vote!" (TE, p.825A) for one such example, but allow students to ask their own question(s) and collect their own data. Teaching Tool 49 offers a blank tally chart and picture graph. Consider posting just the picture graphs from the *On-Level* and *Advanced Activity Centers*, "Look and See" (TE, p. 825A). Encourage students to write questions they have or things they notice about the data on sticky notes and place them under the graphs.
Lesson 14-5: Draw Conclusions From Graphs		
2.MD.D.10 2.OA.A.1 MP.1 MP.3 MP.4 MP.7	Access Prior Learning: In first grade (1.MD.C.4), students organized, represented and interpreted data with up to three categories using picture graphs and bar graphs. Students also compared how many more or less in each category. In lesson 14-3, second grade students learned about bar graphs. In lesson 14-4, second grade students learned about picture graphs. Developing the Big Idea: In this lesson, students are *developing* understanding of how to draw conclusions from picture graphs and bar graphs.	The focus of this lesson supports *Step 3*: *Analyze Data* and *Step 4: Interpret Results* of the statistical process. This focus helps students to understand that graphs provide information. When students create their own graphs, they are more invested, and gain a better understanding of how information is presented (Van de Walle, et al., 2014, p.343). It is helpful to ask students, "What does the graph tell us about _____?" Students will come to understand that graphs convey information (e.g., Most students like math more than any other subject.), and that we can make inferences about the data (e.g., Math is fun and engaging for those students) (Van de Walle, et al., 2014, p.349). Solve & Share: Reference the *Analyze Student Work* (TE, p. 827) for possible student solutions. Although the picture graphs in Mike's Work and Leah's work is correct, the lack of alignment of picture symbols makes the data difficult to interpret. Students may benefit from support with how to draw symbols that are aligned to make the data easier to count and compare. To extend early finishers, ask them to write a response to, "What new questions arise from these data?" or "What does the graph *not* tell us?" Visual Learning: Extend the *Visual Learning* by looking for opportunities to ask students *Put Together, Take Apart* and *Compare* word problems using the data presented (NVACS, 2010, p. 88). For example, a *Put Together* problem might read: How many tickets did Kim and Neil sell together? *-continues on next page-*

		A *Take Apart* problem could read: Two children sold a total of 6 tickets. Who sold the tickets, and how many did each child sell? [This problem offers two solutions: Leah (2) and Neil (4) OR Tino (1) and Kim (5).] Finally, a *Compare* problem may read: How many fewer tickets did Leah sell than Kim? Assess and Differentiate: Rather than doing the *On-Level* and *Advanced Activity Centers*, "Problem-Solving Reading Mat" (TE, p.831A), engage all students in the statistical process (see the Instructional Note at the beginning of this document) so that they can "see themselves" in the data. Reference the Intervention Activity, "Analyzing Graphs" (TE, p.831A) for one such example, but allow students to ask their own question(s) and collect their own data. Teaching Tools 47, 48, and 49 offer blank data tables, bar graphs, tally charts and picture graphs. *CTC: *Quick Check* (digital platform)
Lesson 14-6: Math Practices And Problem Solving: Reasoning		
2.MD.D.10 2.OA.A.1 MP.1 MP.2 MP.3 MP.4 MP.6 MP.8	Access Prior Learning: Second grade students focused on Math Practice 2: Reason abstractly and quantitatively in Topics 7 and 8. Securing the Big Idea: In this lesson, students are *securing* understanding of Math Practice 2: Reason abstractly and quantitatively behaviors in the context of second grade.	Students focused on MP2. Behaviors in Topics 7 and 8. Reference the Math Practices and *Problem Solving Handbook* for suggestions for developing, connecting and assessing MP.2 (TE p.F24-F24A). Also, consider having students self-reflect on their understanding of this math practice using the Self-Assessment Tool (Teaching Tool 65). Self-reflection engages students in metacognition and encourages a growth mindset in mathematics. MP. 2 Behaviors: • Identifies and understands the quantities in the problem. • Shows and explains how quantities are related (e.g., bar diagram). • Translates real-world contexts correctly to numbers, expressions, equations, or concrete or pictorial representations. • Connects numbers, expressions, equations, or concrete or pictorials representations back to real-world contexts. *CTC: *Solve & Share* (student work samples)

References

Common Core Standards Writing Team. (2011, June 20). *Progressions for the Common Core State Standards in Mathematics (draft). K-3 Categorical Data; Grades 2-5, Measurement Data.* Tucson, AZ: Institute for Mathematics and Education, University of Arizona.

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Franklin, C.A., Kader, G., Mewborn, D., Moreno, J., Peck, R., Perry, M., & Scheaffer, R. (2005). *Guidelines for Assessment and Instruction in Statistics Education: A Pre-K-12 Curriculum Framework*. Alexandria, VA: American Statistical Association

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