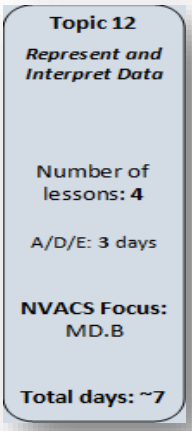
Grade 5 Topic 12: Represent and Interpret Data



5th grade Curriculum Pacing Framework: Balanced Calendar

Big Conceptual Idea: Grades 2-5 Measurement Data (pp. 11-13)

Prior to instruction, view the Topic 12 Professional Development Video located in Pearson Realize online. Read the Teacher's Edition (TE): Cluster Overview/Math Background (pp.695A-695F), the Topic Planner (pp. 695I-695J), all 4 lessons, and the Topic Assessments (pp. 729-730A).

Mathematical Background: Read Topics 12 Cluster Overview/Math Background (TE, pp. 695A-695F)	Topic Essential Question: How can line plots be used to represent data and answer questions? *Reference Answering the Topic Essential Question (TE, pp. 727-728) for key elements of answers to the Essential Question.*

The lesson map for this topic is as follows:

12-1	12-2	12-3	12-4	Assessment

3 A/D/E days used strategically throughout the topic

Instructional Note:

Instruction is focused on Nevada Academic Content Standards (NVACS) cluster 5.MD.B, "Represent and Interpret Data" (2010). This cluster contains one standard:

- 5.MD.B.2- Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Use operations on fractions for this grade to solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were distributed equally.*

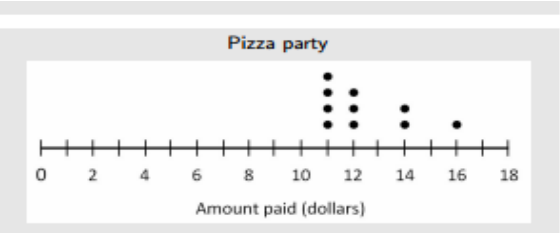
Topic 12 will rely on application of understandings built from working with standards 5.NF.A.2 and 5.NBT.B.6 (NVACS, 2010). Students have prior experience representing and interpreting data going back to first grade and with creating and analyzing line plots since the second grade. Using fractions of a unit is also not unique to fifth grade; it is part of the third and fourth grade standards. Fifth graders have lots of experience with the line plot and are now ready to analyze and work with data at a deeper level.
Karen Karp helps to clarify the intent of standard 5.MD.B.2 by explaining;

> Line plots are a way to organize and represent numerical data collected in a survey. You can use line plots to answer questions about a data set. Students must develop strategies and experience with examining data and unraveling the messages contained within. The interpretation of data is the most important part of the process. (Topic 12 PD video, enVisionmath2.0).

Topic 12 is four lessons in total and the first two lessons (12-1 and 12-2) will review previous grade level standards. Looking for opportunities to push student thinking with questioning will enhance instruction and get to the intent of the standards. After solving the initial problem given, questions such as *"Where is the data clustered? Do more students live close to school or far away?"* and *"How much farther is the longest walk than the shortest walk?"* push students to think more deeply about the data represented on a line plot. Students initial responses to questions such as these are likely to be a reiteration of the data such as "six blocks." Yet, in fifth grade students are capable of making multiplicative comparisons. The longest walk then could be "6 times larger than the shortest walk." Or the difference may represent a whole and a fractional piece such as $2\frac{1}{2}$ times larger. This situation gives students an opportunity to use multiplicative reasoning with fractional pieces. Exploring the mathematical relationships contained within the data set and drawing inferences should be a main focus of instruction during Topic 12. Students are building strategies to effectively interpret data and make decisions.

Standard 5.MD.B.2 also contains something new and unique to fifth grade: *"…For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally"* (NVACS, 2010). The concept of equal sharing is included in the standard. The enVisionmath2.0 lessons for Topic 12 will not cover this part of the standard in a *Solve and Share* or *Visual Learning Bridge*. It is touched upon in question 8 on the *Math Practices and Problem Solving* page for lesson 12-3.

An example of a question to build toward the understanding required by standard 5.MD.B.2 is given in the Grade 2-5 Measurement Data Progression Documents for the Common Core Math Standards on p. 13. This task could be modified and used during instruction to deepen understanding around equal sharing and analyzing data.



Example 3. Fair share averaging

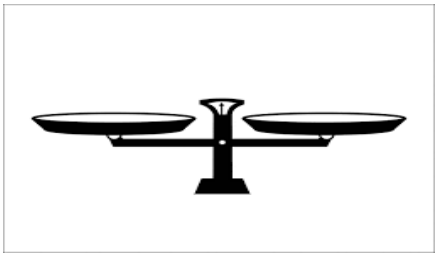
Ten students decide to have a pizza party and each is asked to bring his or her favorite pizza. The amount paid (in dollars) for each pizza is shown in the plot to the right.

Each of the ten is asked to contribute an equal amount (his or her fair share) to the cost of the pizza. Where does that fair share amount lie on the plot? Is it closer to the smaller values or the large one? Now, two more students show up for the party and they have contributed no pizza. Plot their values on the graph and calculate a new fair share. Where does it lie on the plot? How many more students without pizza would have to show up to bring the fair share cost below $8.00?

This same concept could be applied to most of the line plot examples used in Topic 12 by changing the context to contain the idea of equal sharing. Using concrete tools is highly recommended for this task! This task can be very challenging for fifth graders. Some students may pull the data off of the number line to add it up and then fair share the pieces. Challenge students to keep the data on the number line and begin by moving the outer pieces closer to each other. As students become more comfortable with this concept they will naturally begin to use multiplicative reasoning to find a central point for the data. As they progress, they may find the need to create smaller and smaller fractional units on the number line. Questioning can draw out big mathematical ideas learned through working with the data. For example; questions such as "C*an you find where the central point is by looking at how data is clustered? How do outliers change the shape of the data? Do they change where we find the central point? Why?"* ask students to think about data as a whole versus individual pieces of information. This task allows students to begin thinking about data as having a balance point. This interpretation is of data is explained by Van de Walle, Karp and Bay-Williams (2014),

> Balance Point Interpretation: Statisticians think about the mean as a point on a number line where the data on either side of the point are balanced. To help think about the mean in this way, it is useful to think about the data placed on a line plot. What is important is not how many pieces of data are on either side of the mean or balance point but the distances from the mean (p. 451).

Through this work, students are discovering, experiencing and working towards the idea of measures of central tendency (i.e., mean) in a way that will build conceptual understanding and prepare them for later grades.



Math Practice 3: Construct viable arguments and critique the reasoning of others

Focus on opportunities for students to develop *Mathematical Practice 3* behaviors as this is the focus of the Math Practices and Problem Solving, lesson 12-4. Reference the Teacher's Edition (TE, pp. F23-F23A) and the NVACS (2010, p. 6).

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)
	data *line plot* *outlier*

Additional terminology that students may need support with: *analyze, frequency table*

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 questions: "Can students use the information in a data set to create a line plot?"
"Are students able to use the information given in a table and/or line plot to solve problems?"

Lesson	Evidence	Look for
12-2	*Math Practices and Problem Solving* (student work samples) Items 8, 9 and 10	Focus CTC around the big idea: • accurate creation of a line plot to display given data. • use of data to solve a problem, use of operations on fractions.
12-2	*Homework and Practice* (student work samples) Items 1 and 2	Focus CTC around the big idea: • accurate creation of a line plot to display given data. • use of data to solve a problem, use of operations on fractions.
12-2	*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 Performance Assessments* SE pp. 727-730	Use *Scoring Guide* TE pp. 727-730A

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

NVACS (Content and Practices)	Mathematical Development of the Big Idea	Instructional Clarifications & Considerations
Lesson 12-1: Analyze Line Plots		
5.MD.B.2 MP.1 MP.2 MP.5 MP.6 MP.7	Access Prior Learning: Students have worked with line plots in previous grades. In 4th grade, students used line plots to display data in fractions of a unit (4.MD.B). Developing the Big Idea: Students build conceptual understanding and procedural skill working with data displayed on a line plot.	Solve and Share: Students use a given line plot to solve a problem. Where does the information used to create a line plot come from? Why is data recorded on a line plot? How do line plots help us to analyze data? Visual Learning: The connection between a data table and a line plot is shown. Why is data organized into a line plot? Can students generalize ideas about when a line plot can be used as a tool for analyzing data? The term outlier is explained. Are students able to make observations about the data as a whole? Fractional units are used throughout the *Guided and Independent Practice* problems. How is reading a line plot similar to working with number lines? Consider items such as 10 and 14 on the *Math Practices and Problem Solving* page to give experience with more in depth questions. Are students able to determine what data is needed to answer the question being asked? Assess and Differentiate: *Another Look!* models using a line plot to find the mode for a set of data. However, it is not necessary to use the term mode in the explanation.
Lesson 12-2: Make Line Plots		
5.MD.B.2 MP.1 MP.2 MP.4 MP.6 MP.7 MP.8	Access Prior Learning: Students have worked with line plots in previous grades. In 4th grade, students used line plots to display data in fractions of a unit (4.MD.B). Developing the Big Idea: Students build procedural skill in making a line plot to display data including fractions of units.	Solve and Share: Students organize a given set of raw data. Look for students creating frequency tables and line plots. Consider facilitating a discussion comparing these two visual representations. How does each help make data easier to analyze? Visual Learning: A similar problem is given and creating a frequency table and a line plot is modeled. Can a frequency tables be used to organize data before creating a line plot? How do these representations of the data help to solve problems? The *Look Back!* asks a question that can be answered using a line plot display. *-continues on next page-*

		Assess and Differentiate: The *Intervention Activity* asks a question and student responses to gather information then use this to make a frequency table and a line plot. This activity can be used whole class or with small groups. *CTC: *Math Practices and Problem Solving* (student work samples) Items 8, 9 and 10 *CTC: *Homework and Practice* (student work samples) Items 1 and 2 *CTC: *Quick Check* (digital platform)
Lesson 12-3: Solve Word Problems Using Measurement Data		
5.MD.B.2 5.NF.A.2 5.NBT.B.6 MP.1 MP.2 MP.3 MP.4 MP.8	Access Prior Learning: Students have worked with line plots in previous grades and lessons. Securing the Big Idea: Students build procedural skill using data from a line plot to solve problems.	Solve and Share: Students are asked to make observations about what is different in the amounts of rainfall using data in a line plot. This open ended question may generate varying solutions. Consider using student observations to facilitate a discussion comparing found differences. Were similar operations used to find the differences? How do we know which operations to apply when analyzing data? Visual Learning: Using multiplication/repeated addition is modeled as a strategy to solve a problem using data found in a line plot and a frequency table. Are students able to draw connections between the methods used in the *Visual Learning Bridge* and their own strategies used during the *Solve and Share*? *Guided and Independent Practice* items focus on modeling a problem with an equation to solve a problem. On item 5 on the *Independent Practice* page, look for students adding up the numbers from the line plot and ignoring the frequency. Why will this method not work for this problem type? Assess and Differentiate: *Another Look!* gives a problem very similar to the *Visual Learning Bridge* with room on the frequency table for students to apply multiplication and calculate values to solve a problem. The *Reteach* page reviews using operations with fractions before asking students to apply and solve problems using a frequency table.
Lesson 12-4: Math Practices and Problem Solving- Critique Reasoning		
5.MD.B.2 5.NF.A.2 5.NBT.B.6 MP.1 MP.2 MP.3 MP.4 MP.6	Access Prior Learning: Students have used the thinking habits of MP.3 in previous grades and lessons. Students have worked with line plots in previous grades and lessons. Securing the Big Idea: Students apply knowledge of line plots and use habits of MP.3 to solve a real world problem.	Solve and Share: Students critique the reasoning of given statements using a line plot. Consider facilitating a discussion focused on student using mathematical reasoning to justify their explanations. How are they modeling the thinking habits of MP.3? Visual Learning: The habits of MP.3 are modeled to solve a problem using data contained in a line plot. Can students connect the thinking modeled in the *Visual Learning Bridge* to their own thinking and explanations shared during the *Solve and Share*? Students may see the thinking they used explained in written form with precise mathematical vocabulary. Assess and Differentiate: *Another Look!* Provides a problem very similar to the *Visual Learning Bridge.* Have students practice the habits modeled on the items on the *Homework and Practice* page.

References

Council of Chief State School Officers. (2010). The Nevada Academic Content Standards. Retrieved from http://www.doe.nv.gov/uploadedFiles/nde.doe.nv.gov/content/Standards_Instructional_Support/Nevada_Academic_Standards/Math_Documents/mathstandards.pdf.

Common Core State Standards Writing Team. (2015, March 6). *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.

Van de Walle, J., Karp, K., Lovin, L., & Bay-Williams, J. (2014). Teaching student-centered mathematics: Developmentally appropriate instruction for grades 6-8 (2nd ed.). New York, NY: Pearson.