Grade 5 Mathematics, Quarter 4, Unit 4.1

Representing and Interpreting Data on a Line Plot

Overview

Number of instructional days: 8 (1 day = 45–60 minutes)

Content to be learned

- Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8).
- Solve problems using fraction operations involving information presented in a line plot.

Mathematical practices to be integrated

Make sense of problems and persevere in solving them.

- Analyze given information to develop possible strategies for solving the problem.
- Evaluate progress toward the solution and make revisions if necessary.

Use appropriate tools strategically.

- Use tools when solving a mathematical problem and to deepen their understand of concepts.
- Make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations.

Attend to precision.

- Specify units of measure and use label parts of graphs and charts.
- Strive for accuracy.

Essential questions

- How can a line plot help you to answer questions about a set of data?
- How can you create a line plot to display your set of data?
- When would a line plot be a better visual representation for data than another type of graph?
- What symbol is used in a line plot to show frequency?

Written Curriculum

Common Core State Standards for Mathematical Content

Measurement and Data 5.MD

Represent and interpret data.

5.MD.2 Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 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 redistributed equally*.

Common Core Standards for Mathematical Practice

1 Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

5 Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6 Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

Clarifying the Standards

Prior Learning

In grade 2, students show measurement by making a line plot with a whole number unit scale. In grade 3, students show 1/2s, 1/4s, and wholes on the line plot they create. In grade 4, students add 1/8s and solve addition and subtraction of fraction problems using the line plot and data presented on it.

Current Learning

In grade 5, students continue displaying fractional measurement data in ¼, ½, and $^1/_8$ units on line plots and solving problems with the information. At this point, line plots displaying fractional data are at the drill and practice level. The use of the information in problem situations is at the reinforcement level. This is a moderately important content area.

Future Learning

In grade 6, students begin to display data on a variety of plots, like number lines, dot plots, histograms, and box plots.

Additional Findings

Using a graph to analyze a well-understood context can deepen a student's understanding of a graph and graphing. (A *Research Companion to the Principles and Standards for School Mathematics,* p. 256)

Grade 5 Mathematics, Quarter 4, Unit 4.2

Using a Coordinate Grid to Graph Points and to Analyze Patterns and Relationships

Overview

Number of instructional days: 10 (1 day = 45–60 minutes)

Content to be learned

- Use a pair of perpendicular lines (called axes) to define a coordinate system.
- Determine that a given point in the plane is located by using an ordered pair, called its coordinates.
- Understand that the first number indicates how far to travel from the origin (0.0) in the direction of one axis (*x*-coordinate) and the second number indicates how far to travel in the direction of the second axis (*y*-coordinate).
- Graph points in the first quadrant of the coordinate plane.
- Determine the relationship between the *x* and *y* axis on a coordinate grid.
- Generate 2 numerical patterns given 2 rules.

Mathematical practices to be integrated

Model with mathematics.

- Analyze mathematical relationships to draw conclusions.
- Identify important quantities in a practical situation and map their relationships using tools as diagrams, two-way tables, graphs, flowcharts and formulas.

Attend to precision.

- Specify units of measure and use label parts of graphs and charts.
- Strive for accuracy.

Essential questions

- How do you plot a point on a coordinate grid?
- How can plotting ordered pairs on a graph help you to solve problems?
- How can you find the relationship between two sequences on a grid?
- How is a coordinate grid used to find the distances between places on a grid?

Written Curriculum

Common Core State Standards for Mathematical Content

Geometry 5.G

Graph points on the coordinate plane to solve real-world and mathematical problems.

5.G.1 Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., *x*-axis and *x*-coordinate, *y*-axis and *y*-coordinate).

5.G.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

Operations and Algebraic Thinking 5.OA

Analyze patterns and relationships.

5.OA.3 Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. *For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.*

Common Core Standards for Mathematical Practice

4 Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

6 Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

Clarifying the Standards

Prior Learning

In grade 4, students draw points, lines, line segments, rays, angles, and perpendicular and parallel lines. Students have been working with line plots since grade two, so they have a knowledge of scale and number lines since then.

Current Learning

Students begin to use coordinate grids plotting ordered pairs (coordinates) on number lines (axes) that intersect at a point of origin (0,0). The first number shows how far from the origin to move in the direction of one axis and the second shows how far to travel in the direction of the second axis. The names of the axis and the coordinates correspond [(x-axis (x-coordinate)] [(y-axis (y-coordinate)]. Students will also graph points in the first quadrant of the coordinate plane to show real world and math problems and explain the values of the coordinate according to the circumstance or context. Using and plotting ordered pairs on two axes is developmental. However, students have plotted on a line plot for years, so this is at the reinforcement level of instruction. The technique should be quickly assimilated into student repertoire. This is minor content area.

Future Learning

Grade 6 students draw polygons in the coordinate plane when they are given coordinates for the vertices. They use coordinates to find lengths of sides of polygons by joining points. In addition, they use these skills to solve math and real world problems.

Additional Findings

According to *Principles and Standards for School Mathematics,* "Using coordinates, students can specify paths between locations and examine symmetry, congruence, and similarity of shapes drawn on the grid. They can also explore methods for measuring the distance between locations ... and expand to include negative numbers" (p. 167).

Grade 5 Mathematics, Quarter 4, Unit 4.3

Classifying 2-D Figures

Overview

Number of instructional days: 6 (1 day = 45–60 minutes)

Content to be learned

- Understand that the attributes of two-dimensional figures.
- Classify two-dimensional figures in a hierarchy based on properties.
- Understand that all two-dimensional figures also belong to subcategories within each category.

Mathematical practices to be integrated

Construct viable arguments and critique the reasoning of others.

- Develop and communicate arguments about 2-D figures related to their attributes, properties, and categorization.
- Engage in thoughtful dialogue with peers in which they critique each other's arguments.

Use appropriate tools strategically.

- Properly select and apply relevant tools to classify and determine properties of 2-D figures.

Essential questions

- What does two-dimensional mean?
- What are two-dimensional figures?
- How do you classify triangles?
- How do you classify quadrilaterals?
- How are the special quadrilaterals related to each other?
- What are the similarities and differences between a trapezoid and a rhombus?

Written Curriculum

Common Core State Standards for Mathematical Content

Geometry 5.G

Classify two-dimensional figures into categories based on their properties.

5.G.3 Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. *For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.*

5.G.4 Classify two-dimensional figures in a hierarchy based on properties.

Common Core Standards for Mathematical Practice

3 Construct viable arguments and critique the reasoning of others.

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

5 Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6 Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

Clarifying the Standards

Prior Learning

In grade 1, students begin distinguishing the attributes of shapes by building and drawing shapes, composing two and three-dimensional shapes and partitioning shapes. In grade two, students are able to identify and draw shapes with a certain number of angles and equal faces. They continue to count, partition, and share shapes. In grade 3, students categorize shapes into categories and subcategories, recognizing that shape share attributes in multiple ways. They partition shapes into equal parts and label each part as a unit fraction of the whole. In grade 4, students draw points, lines, line segments, rays, angles, perpendicular and parallel lines and angle size. They include right triangles when categorizing and identify them. Symmetric lines and figures are identified and symmetric lines are drawn.

Current Learning

In grade 5, students comprehend that if two-dimensional figures have attributes under a category, they also belong in subcategories of that category. Students also classify two-dimensional shapes in a hierarchy based on properties. This is a minor content area. The level of learning is reinforcement because it builds on prior learning.

Future Learning

In grade 6, future students are able to identify and show 3-D figures by constructing nets from rectangles and triangles and also use the nets to find surface area.

Additional Findings

Students investigate, describe, and reason about decomposing, combining, and transforming polygons to make other polygons. Through building, drawing, and analyzing two-dimensional shapes, students understand attributes and properties of two-dimensional space and the use of those attributes and properties in solving problems, including applications involving congruence and symmetry. (*Curriculum Focal Points,* NCTM, p. 14)

In grades 3–5, students should develop more precise ways to describe shapes, focusing on identifying and describing the shape's properties and learning specialized vocabulary associated with these shapes and properties. As students' ideas about shapes evolve, they should formulate conjectures about geometric properties and relationships. (*Principles and Standards for School Mathematics*, pp. 165–166)

Grade 5 Mathematics, Quarter 4, Unit 4.4

Write, Understand, and Interpret Numerical Expressions

Overview

Number of instructional days: 7 (1 day = 45–60 minutes)

Content to be learned

- Use parentheses, brackets, or braces in numerical expressions.
- Evaluate expressions using parentheses, brackets, or braces.
- Write simple expressions illustrating an understanding of the relationship between words to numbers and numbers to words.
- Interpret numerical expressions without evaluating them—recognize that 3 × (189 + 241) is three times as large as 189 + 921, without having to calculate the indicated sum or product.

Mathematical practices to be integrated

Reason abstractly and quantitatively.

- Contextualize and decontextualize in and out of real world situations and back to context.

Attend to precision.

- Use clear, precise language, explanations, definitions, and vocabulary.
- Explain the meaning of symbols.
- Clarify using labels, careful to use units of measure accurately.
- Calculate accurately.
- Be able to explain understanding to others.
- Examine and find evidence for arguments.

Essential questions

- What is the purpose of parentheses, brackets, or braces in numerical expressions?
- Interpret the outcome if parentheses, brackets, or braces were removed, moved, or changed in simple expressions.
- What does it mean if an expression has parentheses, brackets, or braces?
- What does it mean if an expression does not have parentheses, brackets, or braces?

Written Curriculum

Common Core State Standards for Mathematical Content

Operations and Algebraic Thinking 5.OA

Write and interpret numerical expressions.

5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

5.OA.2 Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as 2 × (8 + 7). Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product.*

Common Core Standards for Mathematical Practice

2 Reason abstractly and quantitatively.

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

6 Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

Clarifying the Standards

Prior Learning

Students wrote and evaluated simple numerical expressions that did not include parentheses, brackets, or braces. Students used a letter/symbol for the unknown number when representing problems. In grades 3 and 4, students used letters/symbols for unknown numbers. In grade 2, students used symbols for unknown numbers.

Current Learning

Students use parentheses, brackets, or braces in numerical expressions and evaluate expressions with these symbols. They also write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them—for example, express the calculation "add six to the quotient of fifteen divided by three" as (15 / 3) + 6) or the calculation (2 x 5) + 13 is thirteen more than the product of two and five.

This learning is at the developmental level—and at the third level of priority with regard to instructional emphasis. This extends previous knowledge by including parentheses, brackets, and braces when evaluating expressions. This is not a critical area of priority in grade 5.

Future Learning

Students in sixth grade will be able to solve expressions and create, identify, and solve equivalent expressions using properties of operations, order of operations, and/or conventional operations. In addition, students will utilize arithmetic operations including those with exponents. After variables are introduced, sixth-grade students will be able to explain their understanding of an expression when numbers are input for variables. Lastly, students will be learning to label and name parts of an expression.

Additional Findings

According to *Principles and Standards for School Mathematics*:

"At this grade band, the idea and usefulness of a variable (represented by a box, letter, or symbol) should also be emerging and developing more fully. As students explore patterns and note relationships, they should be encouraged to represent their thinking. As students become more experienced in investigating, articulating, and justifying generalizations, they can begin to use variable notations and equations to represent their thinking. Teachers will need to model how to represent thinking in the form of equations. In this way, they can help students connect the ways they are describing their findings to mathematical notation. Students should also understand the use of a variable as a placeholder in an expression or equation. For example, they should explore the role of n in the equation $80 \times 15 = 40 \times n$ and be able to find the value of n that makes the equation true. **Note:** In grades 5–6, this standard changes from operations and algebraic thinking to evaluating expressions and equations" (p. 161).