Grade 5
Mathematics
Unit 3: Data and Data Analysis

Time Frame: Approximately four weeks

Unit Description

This unit uses graphical settings to review and practice the operations on whole numbers. This unit introduces students to the coordinate grid and relates it to visual representation of numbers.

Student Understandings

Students organize, display, and interpret data. They practice the operations on whole numbers in different graphical representations including the coordinate plane.

Guiding Questions

1. Can students work proficiently with whole numbers and their operations in graphical settings?
2. Can students organize, display, and interpret data?
3. Can students identify and plot points on a coordinate grid?

Unit 3 Grade Level Expectations (GLEs) and Common Core State Standards (CCSS)

Grade-Level Expectations	
GLE #	**GLE Text and Benchmarks**
Number and Number Relations	
7.	Select, sequence, and use appropriate operations to solve multi-step word problems with whole numbers (N-5-M) (N-4-M)
8.	Use the whole number system (e.g., computational fluency, place value, etc.) to solve problems in real-life and other content areas (N-5-M)
Data Analysis, Probability, and Discrete Math	
27.	Identify and plot points on a coordinate grid in the first quadrant (G-6-M)
28.	Use various types of charts and graphs, including double bar graphs, to organize, display, and interpret data and discuss patterns verbally and in writing
CCSS for Mathematical Content	
CCSS#	**CCSS Text**
Operations and Algebraic Thinking	
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 two patterns, and graph the ordered pairs on a coordinate plane.

Measurement and Data	
5.MD.2	Make a line plot to display a data set of measurements in fraction of a unit (½, ¼, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots.
ELA CCSS	
CCSS#	**CCSS Text**
Writing Standards	
W.5.2a	Write informative/explanatory texts to examine a topic and convey ideas and information clearly. a. Introduce a topic clearly, provide a general observation and focus, and group-related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.
Language Standards	
L.5.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal contrast, addition, and other logical relationships.

Sample Activities

Activity 1: Graphing Vocabulary (GLE: 28; CCSS W.5.2a, L.5.6)

Materials List: Graphing Vocabulary BLM, pencils

Before beginning the graphing activities, have students complete a *vocabulary self-awareness* (view literacy strategy descriptions) chart. Provide students with the Graphing Vocabulary BLM. A sample grid is shown below. Include different words. Do not give students definitions or examples at this point.

Word	**+**	**√**	**–**	**Example**	**Definition**
axis					
scale					
mean					
median					
mode					
range					
cluster					
gap					

Ask students to rate their understanding of each word with either a "+" (understands well), a "√" (some understanding), or a "–" (don't know). During and after completing

the graphing activities 2 through 9, students should return to the chart and fill in examples and definitions in their own words. Some words will have a "+", a "√", and a "–" by the end of the activities. The goal is to have plus signs for every word at the end of the activities. After all the words have been covered, be sure to check students' charts to make sure definitions are accurate and examples are appropriate.

Activity 2: Spinning Bar Graph (GLEs: 28)

Materials List: Spinning Bar Graph Anticipation Guide BLM, Spinners BLM, Bar Graph BLM, colored pens or crayons, pencils, paper, paper clips, transparent spinners – optional

Begin the lesson by providing the students with the *Spinning Bar Graph Anticipation Guide* BLM. *Anticipation Guides* (view literacy strategy descriptions) are used to appraise the students' prior knowledge before the new concept is introduced and evaluate knowledge that was acquired through their exploration of the concept. *Anticipation Guides* are done on an individual basis and can be used as a catalyst for small group discussions. *Anticipation Guides* are especially helpful to struggling and reluctant learners as they increase motivation and focus attention on important content. This guide can be given in handout form, written on the board, overhead or with use of a document camera.

Tell students to respond to the statements on the BLM and be prepared to explain their responses. Put students in pairs and have them compare and discuss their responses before beginning the spinning activity. At this stage of the activity, emphasize that there are no "correct" answers and that students should feel free to discuss their responses. Tell the students they are about to participate in an activity to prove or disprove the answers generated on the *Anticipation Guide*. Provide each pair of students the Spinners BLM, the Bar Graph BLM, colored pens or crayons, and a transparent spinner or a paper clip and a pencil to use as a spinner. Have one student in the pair to spin Spinner A 20 times and the other student record the outcome of each spin. On the Bar Graph BLM, have each pair of students make a bar graph of the outcomes. Discuss the labels that should be shown on the horizontal and vertical axes. Allow students to choose the scale. At appropriate points in the activity, have students return to their *Anticipation Guide* statements and confirm or revise their original responses based on what they learned. Engage students in a discussion about their *Anticipation Guide* responses to clarify any misconceptions.

Name: _____ Date: _____

Spinning Bar Graph Anticipation Guide Statements

Spinner A

1. Look at Spinner A. Suppose you spin Spinner A 20 times. Red has the best chance of being spun.
   True_____ False_____
2. Green has a better chance of being spun over any other color.
   True_____ False_____
3. If the spinner is spun clockwise, blue has a better chance of being spun because it is the first color.
   True_____ False_____
4. Since red and green are diagonal to each other they have an equal chance of being spun.
   True_____ False_____
5. Yellow is least likely to be spun.
   True_____ False_____
6. Each color is equally represented on the spinner.
   Yes_____ No_____

For more practice in creating graphs, use Spinner B. Have students spin 20 times, record the results, and graph the results. Have them compare this graph with the first one created.
As a variation of this activity, have students collect data on classmates' favorite colors and create a bar graph.

Activity 3: Survey Preferences (GLEs: 7, 28; CCSS W.5.2a)

Materials List: paper, pencils, Bar Graph BLM, math learning logs

Have students work in groups of 3 or 4. Have each group write a survey question such as, "Do you prefer cats or dogs as pets?" or "Do you own a computer?" Have each group survey the boys and girls in the class separately. Distribute the Bar Graph BLM. Have students tally the data and make a double bar graph of the data, showing the preference for each gender group. Have students present their graphs to the class, pointing out the title, vertical and horizontal axes, scale interval, and bars. Have students write word problems to go along with their graphs. Some word problems should involve multiple steps. In their math *learning logs* (view literacy strategy descriptions), have students answer the following question: How does changing the scale on a bar graph change the look of the bar graph?

Activity 4: Line Plots (GLEs: 8, 28; CCSS: 5.MD.2, W.5.2a)

Materials List: paper, pencils

Through *SPAWN writing* (view literacy strategy descriptions) prompts, such as "What if?" a thought-provoking activity can be created related to the use of graphs to display information. Ask students to answer this prompt: What if you were a clothing designer and you want to design a really popular shirt. You are unsure as to the number of buttons you should put on the shirt. What could you do to collect information on the number of buttons on the typical shirt that your classmates wear? How could you organize and display the data you collect to convince the owner of the company as to the number of buttons you want to put on the shirt?

Use the different responses as a springboard to discuss different types of graphs. If no one thinks of a line plot, do the following activity. As a whole class, collect data on the number of buttons that students have on their clothing that day. (In schools where students wear uniforms, collect data of the number of buttons on the students' favorite shirts.) Use a line plot to collect the data. Generally, the number of buttons will fall between 0 and 15. Discuss the information, using terms such as range, clusters, and gaps. Have students find the mode, median, and mean. Have students practice operations on whole numbers when finding the mean.

To help students who may have difficulty finding the three measures of central tendency, give the numbers 53, 95, 78, 62, 62. Help students find the mean (70) by having them add the numbers in the set of data and dividing the sum (350) by the number of addends (5). Further explain that the mean is also known as the average of the data set. To find the median, have the students arrange the data set in order from least to greatest. Tell the students to locate the number in the middle (62). This number is the median. Inform the students that when there is an even amount of numbers, the median is the average of the two middle numbers. Have students add 100 to the data set and find the new median (the average of 62 and 78 or 70). Remind students that the mode is the number (value) that occurs most often. Have the students find the mode in the data set (62).

As a whole class, have students decide on another question. Separate students into small groups. Instruct each group to survey a total of 20 people outside the classroom on this question and make a line plot of the data. Have students discuss the results of the data from the different groups.

Activity 5: M&M Spreadsheet Math (GLEs: 7, 28; CCSS W.5.2a)

Materials List: Bar Graph BLM, M&Ms®, computer, paper, pencils, spreadsheet program – optional

Using one-serving size bags of M&Ms® per group, have students sort the candy by color and make a group bar graph by hand on the Bar Graph BLM. Make sure that the students name the graph and label both axes.

To incorporate technology using the data gathered, input the data into a spreadsheet. Have the students construct a data table and make a bar graph from the options menu. Observe the computer-generated bar graph in addition to the one they made by hand.

Using the same data, have students create a small group pictograph. Have the students use a symbol that represents a number other than one. Allow different groups to use different amounts for their symbols and compare the graphs.

Have students write a math *text chain* (view literacy strategy descriptions) about the information collected in the graphs. Each student in the group contributes a part to the *text chain*. An example of a *text chain* could be: Our group had 8 red M&Ms® in the bag. We also had 11 brown M&Ms® in the bag. How many more brown M&Ms® did we have than red ones? Students in the *text chain* groups should talk about the accuracy of the answer and the logic of the story problem. If necessary, revisions to the *text chain* should be made.

Activity 6: Stem and Leaf Plots (GLEs: 7, 28)

Materials List: paper, pencils, timing device with seconds

Have students work in pairs to do one of the following activities: snap their fingers, jump on one foot, or tap the top of their heads. Act as the timekeeper. Allow 30 seconds. Have one partner count as the other partner performs the activity.

As a class, collect and record the data in a stem and leaf plot. Make a second stem and leaf plot of the same data to organize it into numerical order. This allows students to more easily find the range, median, and mode. Ask questions about the range, clusters, gaps, median, mode, and mean. If students need more practice, repeat the activity using the other hand or foot. Have students write word problems or questions from the plot, making sure that some of the problems are multi-step.

Activity 7: Line Graphs (GLEs: 28)

Materials List: textbooks or newspapers, paper, pencils, The Internet (optional)

Using tables found in social studies books, math textbooks, science books, or newspapers such as *USA Today*, ask students to use the data to make a line graph. Remind students that line graphs show trends or changes over time. Have students discuss any patterns or trends that they observe in the data. Have students compare scales for the graphs and

discuss which scale best shows the data. Discuss the advantages and disadvantages of using different scales with the same data.

Activity 8: Features of Graphs (GLE: 28; CCSS W.5.2a)

Materials List: Types of Graphs BLM, pencils

This activity will help students summarize the important features of different types of graphs. On the board, or overhead projector, draw a *word grid* (view literacy strategy descriptions) like the one below. The *word grid* is a visual technique that provides students with an organized framework for learning words by analyzing the similarities and differences of various words. To take full advantage of *word grids*, the grids should be co-constructed with students, so as to maximize participation in the learning process. Provide students with the Types of Graphs BLM. In the first column, have students help list the types of graphs they have been studying. In the other column headings, have them think of features of the graph, such as these: needs horizontal and vertical axes, needs a scale, shows trends. In each box, they should write A for always, S for sometimes, and N for never. Once the *word grid* is complete, students should be given time to review the differences and similarities among graphs. They can quiz each other over the information in the grid in preparation for tests or other class activities.

Sample Word Grid

Types of graphs	needs a horizontal and vertical axis	shows trends			
bar graph	A	S			
line plot	N	S			
line graph	A	A			

A = always S = sometimes N = never

Activity 9: Which Graph is Best? (GLEs: 28; CCSS W.5.2a)

Materials List: paper, pencils, math learning logs, the computer (optional), spreadsheet program (optional)

Have each group of students design a survey question and ask 12 other students in the class (or 12 people outside of class) the survey question. Students should record the answers in a frequency table. Give the same question to two groups. Suggested questions:

How tall are you in inches? What is your favorite subject? What kind of transportation do you use to get to school? How many brothers do you have?

On the following day, have each group of students graph the data, present their findings, and explain how they made their graphs. Allow students to choose the type of graph they want to use. Hopefully, they will find that some graphs will not work for their given information. In their math *learning logs* (view literacy strategy descriptions), have students write about why they chose a certain graph to display their data. To incorporate technology into the lesson, have students use a spreadsheet to create their graph.

Using the results of the data table and graphs, have students compare and contrast their graphs. They should see differences in the overall graphs, the scales, and the labels.

Activity 10: Coordinate Graphs in the First Quadrant (GLE: 27; CCSS 5.OA.3; W.5.2a)

Materials List: Split-page Notetaking BLM, Coordinate Grid BLM, ruler, pencil

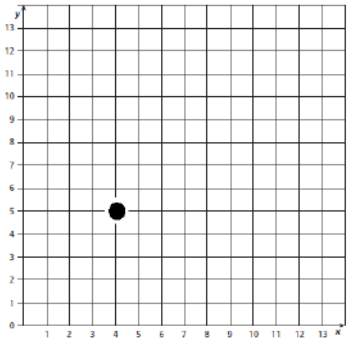
Teacher Note: *The x- and y- axes separate the plane into four parts, or quadrants. Since students at this grade level have not studied negative integers, this activity focuses only on the first quadrant.*

Prior to beginning this lesson, create a coordinate grid on the board or use the Coordinate Grid BLM on a document camera or an overhead projector. Explain to the students that they will use the *Split-page Notetaking* method to help them understand how to read and plot points on a coordinate grid. *Split-page Notetaking* (view literacy strategy descriptions) is a systematic way of taking notes. It helps students record information in an organized way, encourages summarizing and serves as a foundation for review of the material. Give students the *Split-page Notetaking* BLM and the Coordinate Grid BLM. Tell students that they are going to learn about the parts of this coordinate grid. Have students note the similarity of the axes to number lines. Instruct them to write this information on their *Split-page* sheet. "Axes" could be written in the left section and "looks like a number line" could be written in the right section. See the example which follows for sample notes.

Title Coordinate Graphs in the Frist Quadrant Name Joe Student	
axis	*looks like a number line* *x-axis is a horizontal line* *y-axis is a vertical line* *where the x-axis and y-axis intersect is called the origin*
ordered pairs	*pair of numbers that shows the position of a point on a coordinate grid*
coordinates	*the numbers in an ordered pair* *x-coordinate is the first number* *y-coordinate is the second number*

Explain that ordered pairs are used to name the location of points. Instruct students to write that an ordered pair is a pair of numbers that shows the position of a point on a graph. On the coordinate grid created earlier, write the ordered pair (*x*, *y*).

Explain that two numbers are used, an *x*-coordinate and a *y*-coordinate. Have students write on their *Split-page* sheet that an *x*-coordinate and a *y*-coordinate are two numbers used to name the location of any point. The word "coordinate" could be used on the left side of the sheet. Explain that the *x*-coordinate tells where the point is along the horizontal or *x*-axis and the *y*-coordinate tells where the point is along the vertical or *y*-axis. Write "(*x*, *y*) means (↔, ↕)" beside the coordinate grid. See the coordinate grid below.



(x, y)
(x, y) means (↔, ↕)
(4, 5)

(1, 0) and (0, 1)

Write the point (4, 5) and show how it is located 4 units over (*x*-axis) and 5 units up (*y*-axis). Create other points as needed to help with understanding. Write the ordered pairs (1, 0) and (0, 1) beneath the coordinate grid. Discuss with students how to decide where each point should be plotted. Invite a student to plot the points on the coordinate grid. Encourage students to share different methods they might use to remember what each coordinate of an ordered pair represents.

Once students complete their *Split-page Notes*, allow time for them to review individually and with partners. Demonstrate how one column of the notes can be covered and information in the other column can be used to prompt recall of the covered information.

Have students work in pairs. Ask one partner to identify a location on the coordinate grid, such as (3, 4), and to challenge the other partner to plot a point at that location or to plot a point and challenge the other to name its location. Have partners exchange roles. After giving pairs adequate time to practice reading and plotting points, have them answer the following prompt in their math *learning logs* (view literacy strategy descriptions), "Using words and pictures, explain how to plot (5, 10) on a coordinate graph. Be sure to mention the *x*-axis and the *y*-axis." Afterward, students can share their responses with partners and check for accuracy.

Activity 11: Plotting Pairs (CCSS: 5.OA.3)

Materials List: 2 number cubes, coordinate grid paper or Plotting Pairs BLM, math learning log

Provide students with grid paper or copies of Plotting Pairs BLM. Coordinate graphs are also known as motion graphs in science. Remind students that the origin (0, 0) is the point where the *x*- and *y*-axes intersect. Also remind them that points on the grid are known as ordered pairs (*x*, *y*) and that when plotting points, the *x* value is plotted first and then the *y* value is plotted. Students may want to write (↔, ↕) on their activity sheet before completing the activity.

Have students work in pairs. Have each partner roll a number cube. Have the pair write two ordered pairs using the pair of numbers rolled. For example, if the numbers 3 and 5 were rolled, students could write the points (3, 5) or (5, 3). Have students plot and label both points on the coordinate grid. After the points are plotted, have students discuss what is similar about the two points and what is different and write their discussions in their math *learning logs* (view literacy strategy descriptions). Have students repeat the activity as time permits. When adequate time have been given, have students discuss the similarities and differences found in the ordered pairs they created.

Sample Assessments

General Assessments

- Portfolio assessments could include the following:
  - Anecdotal notes made during teacher observation
  - Any of the journal entries, or one of the explanations from the specific activities

  - Corrections to any of the missed items on the tests
- Journal entries could include the following:
  - Thomas is observing the growth of several basil seeds. He plans to use a graph to show his results. What type of graph should he choose? Explain your answer.
  - Explain how to plot (8, 9) on a coordinate graph.

Activity-Specific Assessments

- Activity 4: Have the student make a second type of graph with data collected in the activity and discuss in writing which graph better displays the data and why.

- Activity 9: Have the student write three questions that could be answered by a graph that he/she constructs.

- Activity 10: Have the students plot the following ordered pairs on a coordinate grid: (0, 0), (1, 2), (2, 4), (3, 6), (4, 8) and explain in writing what he/she did to plot the ordered pairs on the grid.