**How Large of a Tower?**

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| This lesson introduces the idea of posing a question that yields numerical data that can be represented in a line plot. Questions that yield numerical data are new to fourth grade students. |

**NC Mathematics Standards:**

**Measurement and Data**

**NC.4.MD.4** Represent and interpret data using whole numbers.

* Collect data by asking a question that yields numerical data.
* Make a representation of data and interpret data in a frequency table, scaled bar graph, and/or line plot.
* Determine whether a survey question will yield categorical or numerical data.

**Standards for Mathematical Practice:**

1. Make sense of problems and persevere in solving them.

4. Model with mathematics.

6. Attend to precision.

**Student Outcomes:**

* I can create a line plot to represent data.
* I can communicate with others about my data.

**Math Language:**

* data
* numerical data
* line plot

**Materials:**

* graph to display (One-Legged Jumping)
* pattern blocks or multi-link pop cubes (one set per pair of students)
* data display materials such as blank paper, graph paper, poster paper, rulers, yard/meter sticks, and pencils/markers/colored pencils/crayons

**Advance Preparation**:

* Gather materials
* Plan how to group students into pairs

**Launch:**

1. Introduce the Context (10 minutes)

Display the graph “One-Legged Jumping” for the class to see. Ask: *What type of data is on the graph?* Ask: *Why do think a line plot was used to display this data?* Give students time to respond to the questions as partners and then share ideas with the whole class. Point out that the line plot is used to display numerical data. Define numerical data (Data that is measurable. The data can be measurements such as height and weight or number such as the number of teeth or pages in a book.) and point out how it is different from categorical data.

Tell the class that the data represents the number of children who jumped. Ask: *Based on the data, can we determine how many people answered the question?*

* After students respond, remind students that every X stands for a data point or in this case a person. So the number of people surveyed is the same as the number of X’s on the line plot (37 people).

Instruct students to work with a partner or small group to come up with two questions about the data in the line plot. Have a few groups share their questions with the class and discuss how the line plot could be used to help answer the questions.

1. Introduce the Task (10 – 20 minutes)

Say, *“Mathematicians need to work together with others in order to accomplish tasks and projects.”* Tell students that today they are going to work together to build the tallest possible tower.

Give each pair of students a set of pattern blocks OR multi-link/pop cubes and instruct each pair to work together to build the largest possible tower out of blocks. Give students several opportunities to practice building the largest tower and inform them that you are going to record the two largest towers in terms of the number of objects in the tower.

After students have time to build towers and find the two largest heights, the teacher should have students share the data and provide a way to display it for the class to see in a frequency table.

Example:

|  |  |
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| **Number of Blocks** | **Number of Towers** |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |
| 11 |  |

**Explore:**

1. Displaying Data (15 – 20 minutes)

Provide students will materials to create a line plot of the data that was collected. This may include blank paper, graph paper, poster paper, pencils, crayons, markers, colored pencils, rulers, or yard/meter sticks. Instruct students to collaborate with their partner to create a line plot of the collected data.

Observe students as they create the line plots. Carefully select aspects of the graphs that you would like to highlight during the discussion (labels, number line, organization, size or organization of Xs).

Observe:

* What challenges do students have as they create the line plot?
* How do students organize the data? Do they include all of the data points?
* How do students draw the Xs on the line plot? Are they organized and approximately the same size?
* How do students label the numbers on the number line? Are any numbers skipped or not included?
* Do students include a title on the line plot?

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| **Observation** | **Questions to Ask** |
| Students have difficulty creating a line plot. | * What information do we put on the bottom of the line plot? * What does each X on the line plot mean? * How can we be sure that we have included all of the data? |

Once students have made a line plot, have them answer the following questions:

* + How many people made towers?
  + What was the tallest tower built?
  + What was the shortest tower built?

If time allows, have students write two additional questions about the data in the line plot.

**Discuss:**

1. Discussion of Solutions (15 – 20 minutes)

Bring students together to discuss the experience and the data displays. Use the following questions to assist you with the discussion.

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| **Sample Questions** | **Possible Responses or Talk Frames** |
| * What does our data tell us about the class? | * “I learned that students made towers that were \_\_\_.” |
| * Who would like to share your question and tell us about the results? | * Responses will vary based on the question and data. |

Highlight aspects of the line plots (labels, number line, organization, size or organization of Xs) that need to be addressed. Discuss any challenges students had as they were creating the graphs. Also, spend time answering some of the questions posed by students.

Point out that you started the lesson by saying, *“Mathematicians need to work together with others in order to accomplish tasks and projects.”* Ask students to describe the different ways they worked together to complete today’s task. Ask: *What are the benefits of working together on tasks and projects?*

**Evaluation of Student Understanding:**

**Informal Evaluation:**

* Observe students and ask questions as they are creating their line plots. Look for students who may need more support.

**Formal Evaluation:**

* Have students respond to one or more of the following questions in their math journals:
  + Define numerical data. What are some examples of numerical data?
  + What is important to consider when creating a line plot?
  + Describe one thing you learned about line plots.
* As an exit ticket, you can redisplay the “One-Legged Jumping” graph from the beginning of the lesson and ask a “how many more” or “how many fewer” question.

**Meeting the Needs of the Range of Learners:**

**Interventions:**

* For students who struggle creating a line plot, provide them with models of different line plots. Ask questions about what a line plot looks like.
* For students who struggle with organizing a line plot, provide them with graph paper. Have them place one X in each box to keep the Xs organized and a consistent size.

**Extensions:**

* Students can create another investigation on their own, collect data, and create a line plot for their data.
* Students can create a different representation such as a bar graph with the collected data.

**Special Notes:**

* Portions of this lesson could be done as part of a math center or math workshop.

**One-Legged Jumping**

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|  | X |  |  |  |  |  |  |  |  | X |  |
|  | X |  |  | X |  |  |  |  |  | X | X |
|  | X |  |  | X | X |  |  |  |  | X | X |
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|  | X | X |  | X | X | X | X |  |  | X | X |
| X | X | X | X | X | X | X | X | X |  | X | X |
| 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |