Graph it! – Grade Six

Lesson Summary:
In this lesson, the students learn about graphs, stacked graphs, histograms and line plots. They learn how data is represented in the different graphs. Students learn to read, construct and interpret these graphs. Then, they conduct a survey and display the data using one of the graphs in the lesson.

Estimated Duration: Three hours

Commentary:
When using graphs to represent data, it is important that students are able to understand how to analyze as well as create an appropriate graph. This lesson addresses both ideas. Students read, make interpretations, draw conclusions from the graph and analyze the components of the graph. They will then use this knowledge to create graphs from a given a set of data and develop questions related to the graph. Before each part of the lesson, additional commentary provides background information for the teacher to aid in understanding graphs that are not commonly used in the classroom, but are often seen and used in newspapers and magazines.

Pre-Assessment:
- Distribute Pre-Assessment, Attachment A.
- Discuss the appropriateness of the graphs that were constructed with the students in the second part of the pre-assessment. Why were the particular graphs chosen to represent each set of data? Could other graphs be used to represent the data? What additional information would be needed to create other graphs?

Scoring Guidelines:
Use the Pre-Assessment Answer Key, Attachment B, to determine if students are able to construct and read the graphs. Provide intervention for the students who are not demonstrating understanding of the graphs by providing additional tables to interpret and evaluate.

Post-Assessment:
Students design a question and survey a small limited population, such as students in their grade level. After students have made initial conclusions, they sample a larger population and modify conclusions as additional data are collected and justify new findings. When the second survey occurs, students
expand the diversity by including multiple grade levels, ages or family and community members. Students record how the results of the data changed or did not change from the first to the second survey.

- Distribute to students Post Assessment Project, Attachment C to students
- Review with the task with the students.

**Instructional Tip:**
- Make sure students’ questions provide quantitative data. Questions with yes/no responses are not acceptable for this project.

**Scoring Guidelines:**
Use the table to determine the progress students have made toward meeting the expectations. Students are provided with this table on Attachment C, so the expectations are communicated to them before beginning the project.

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Meets Expectations</strong></td>
<td>• Selects a topic and conducts a survey</td>
</tr>
<tr>
<td></td>
<td>• Organizes results of the survey into a table</td>
</tr>
<tr>
<td></td>
<td>• Constructs a graph to visually represent the data</td>
</tr>
<tr>
<td></td>
<td>• Analyzes and interprets the data using the graph as support</td>
</tr>
<tr>
<td><strong>Progressing Toward Expectations</strong></td>
<td>• Selects a topic and conducts a survey</td>
</tr>
<tr>
<td></td>
<td>• Organizes results of the survey into a table</td>
</tr>
<tr>
<td></td>
<td>• Includes minor flaws in constructing a graph and interpreting the data</td>
</tr>
<tr>
<td><strong>Intervention Required</strong></td>
<td>• Selects a topic and conducts a survey</td>
</tr>
<tr>
<td></td>
<td>• Results of the survey are disorganized in the table</td>
</tr>
<tr>
<td></td>
<td>• Includes minor flaws in constructing a graph and interpreting the data</td>
</tr>
<tr>
<td><strong>Re-teaching Required</strong></td>
<td>• Selects a topic and conducts a survey</td>
</tr>
<tr>
<td></td>
<td>• Results of the survey are disorganized in the table</td>
</tr>
<tr>
<td></td>
<td>• Includes major flaws in constructing a graph and interpreting the data</td>
</tr>
</tbody>
</table>

**Instructional Procedures:**
**Part I Stacked Graph**
1. Display *Stacked Graph*, Attachment D, on an overhead projector and distribute a copy to each student.

**Instructional Tips:**
- A stacked graph can show the same information as multiple bar graphs. Stacked graphs combine various bars into one making totals easier to read. As a kind of trade off, it is harder to tell individual totals. Many times individual bars are marked with values but may require some calculation if they are not numbered.
- As the lesson progresses have students develop a checklist of the key components or characteristics of each type of graph in a journal, notebook or chart paper to display in the classroom. Items that students should include in their checklist they develop are descriptions of the visual representation, titles, labels on the axis, intervals, legends, x-axis, y-axis, etc.
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- Discuss how to decide which information goes along the x-axis and which goes along the y-axis. This is hard for some students. How does the graph look different if the axes are switched? Does it matter?

2. Have students work on the questions individually. Move student into small groups and have them compare results. Make sure correct answers are finally presented.

3. Facilitate a class discussion of the characteristics of the graphs using the following as guiding questions:
   - What are some characteristics or key components that you notice about the stacked graph and the bar graph? Create a list on chart paper and instruct students to record these components in their mathematics journals.
   - Compare the stacked graph and the bar graph. How are they alike and how are they different?
   - How is the information organized in each of the graphs?
   - For each of the questions, which graph is easier to obtain the information from?
   - If given only the stacked graph, how do you obtain information about the specific grade levels?
   - How do these graphs represent the same raw data?
   - Direct students to use different graphs and determine if the same answer occurs.

**Instructional Tip:**
List key discussion points on chart paper to use for future reference.

4. Distribute *Time for Lunch*, Attachment E.
5. Instruct students to create a stacked graph using the information provided in the table.
6. Ask students to create five to six questions that could be answered by using the graph they created:

**Part 2 Histogram**

**Instructional Tip**
Histograms are many times confused with bar graphs. However, histograms are a graph that uses bars to display the frequency of data within equal intervals. Think of histograms as “sorting bins”. There is one variable and the data is sorted by this variable by placing the data into “bins”. The pieces of data in each bin are counted. The height of the rectangle drawn on top of each bin is proportional to the number of pieces in that bin. On the other hand, bar graphs have several measurements of different items that allow comparison. Histograms show one set of data and are designed to show trends. Bar graphs on the other hand, display numerical information with labels for each bar and a scale to show amount for each bar.

7. Display *Histogram*, Attachment F, on an overhead projector and distribute a copy to each student.
8. Have the students work on the questions individually. Then, put the students in to pairs or small groups to compare their results.
9. Lead a class discussion about the characteristics of the graph using the following questions as a guide:
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- What are some characteristics or key components do you notice about the histogram? Create a list on chart paper and instruct students to record these components in their mathematics journals.
- How is the information organized in a histogram?
- When would the intervals not need to start at zero?

Instructional Tip:
List key discussion points on chart paper to use for future reference.

10. Distribute Jump Height of Students, Attachment G, to each student.
11. Lead a class discussion of the characteristics of the graph using the following as guiding questions:
   - What is the importance of connecting the bars in a histogram?
   - How will you organize the information in a histogram?
   - How did you determine what the intervals would be for the distribution of the data?
12. Instruct students to create a histogram using the information provided in the table. Then have them create questions to ask about the graph. Provide a guide for students to develop questions requiring different levels of thought and interpretation. For example: Do you think data represents students at one grade level or a variety of grade levels? Why?
13. Instruct students to create five or six questions that require using the graph they created to answer.

Part 3: Line Plot

Instructional Tip:
The terms mean, median, mode, range, outliers, minimum and maximum aid in interpretation of the graph in this lesson. In line plots, a symbol such as x represents numerical data. Ask questions about these statistical measures with this graph.

14. Display Line Plot, Attachment H, on the overhead projector and distribute a copy to each student.
15. Have students work on the questions individually. Then, group students either in pairs or small groups to compare results.
16. Lead a class discussion of the characteristics of the graph using the following as guiding questions.
   - What are some characteristics or key components of a line plot? (Instruct students to record these components in their journals.)
   - Discuss the distribution of the data in the line plot. (Is the data evenly distributed or is the data clustered in a specific part of the line plot?)
   - Why do you think the scale (tic marks) for the line plot does not start at zero?
   - If a data point was removed from the set of data, how does it affect (if at all) the mean, median and mode? (Try removing different data points to demonstrate how outliers affect the distribution of the data.)

Instructional Tip:
List key discussion points on chart paper to use for future reference.
17. Distribute *Student Heights*, Attachment I, and direct students through the activity.
18. Instruct students to create a line plot using the information provided in the table. Then have them create five to six questions that include ideas of distribution, mean, median, mode, range, minimum, maximum and outliers.
19. Lead a class discussion of the characteristics of the graph using the following as guiding questions:
   - What tick marks will you use for your line plot? What is the minimum and the maximum
   - What is the distribution of the data? Describe the shape.
   - Are there any outliers that affect the distribution of the data?
20. Have partners exchange questions and respond to each other’s questions.

**Part Four**
21. Have students work in small groups identifying similarities and differences among the three types of graphs used in this lesson.
22. Have student create a list of these characteristics. An example of this may look like:

<table>
<thead>
<tr>
<th>Common to all Graphs</th>
<th>Stacked Graphs</th>
<th>Histograms</th>
<th>Line Plots</th>
</tr>
</thead>
<tbody>
<tr>
<td>title</td>
<td>categories</td>
<td>data interval</td>
<td>range of values</td>
</tr>
<tr>
<td>axes labels</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

23. Ask student to examine the data and graphs used in the lesson, making assumptions about which type of graph would best represent the data. Try the same data with another kind of graph. Have student continue to examine the graphs to determine if they apply to a specific purpose.

**Differentiated Instructional Support:**
Instruction is differentiated according to learner needs, to help all learners either meet the intent of the specified indicator(s) or, if the indicator is already met, to advance beyond the specified indicator(s).
- Limit the number of populations in the stacked graph to two.
- Adjust the sample size of the data for students who are having difficulty with the amount of data or are able to deal with larger populations.
- Increase the sample size or add another category to challenge students who already have a good understanding of the concept.
- Provide a guide for developing questions that require interpretation, inferential thinking and evaluation of data.

**Extensions:**
- Students create a survey, conduct the survey, and graph the results.
- Have students’ use the original set of data and create another graph by organizing the data by different demographics.
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- Find as many different types of graphs. For each graph found, the students need to name the type of graph and write three questions that relate to the graph. Questions should be of varying difficulty and go beyond the reading of the graph, to the interpretation of the graph.
- Have students use the same set of data to create different graphical representations. Have students think about the appropriateness of the graph and if one graph reveals different information than another.
- Have students use the data from one of the graphs used in the lesson, post assessment or another source and create another graph to represent the data.

**Home Connection:**
Search the newspapers and magazines for graphs. Bring them in and discuss the meaning of the graphs. Ask students to write four questions that can be answered by reading the graph.

**Interdisciplinary Connections:**
Content Area: Language Arts
Standard: Reading Applications: Informational, Technical and Persuasive Text
Benchmark: A: Use text features and graphics to organize, analyze and draw inferences from content and to gain additional information.
Indicator: 5. Analyze information found in maps, charts, tables, graphs and diagrams.

**Materials and Resources:**
The inclusion of a specific resource in any lesson formulated by the Ohio Department of Education should not be interpreted as an endorsement of that particular resource, or any of its contents, by the Ohio Department of Education. The Ohio Department of Education does not endorse any particular resource. The Web addresses listed are for a given site’s main page, therefore, it may be necessary to search within that site to find the specific information required for a given lesson. Please note that information published on the Internet changes over time, therefore the links provided may no longer contain the specific information related to a given lesson. Teachers are advised to preview all sites before using them with students.

*For the teacher:* make overheads of the attachments, large sheets of graph paper

*For the students:* copies of attachments, graph paper, rulers, pencils

**Vocabulary:**
- axes (x and y)
- histogram
- legend
- line plot
- population
- stacked graph
- survey
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**Technology Connections:**
- Use software with graphing capabilities to construct the graphs. Look for data from a survey on-line and create a graph to represent it. Have the class create an online survey using the original questions and post it on the web. Use the data generated from this survey to modify the original graphs.
- Use calculators with graphing capabilities

**Research Connections:**


**General Tip:**
Make overhead transparencies of the attachments.

**Attachments:**
Attachment A, *Pre-Assessment*
Attachment B, *Pre-Assessment Answer Key*
Attachment C, *Post Assessment Project*
Attachment D, *Stacked Graph*
Attachment E, *Time for Lunch*
Attachment F, *Histogram*
Attachment G, *Jump Height*
Attachment H, *Line Plot*
Attachment I, *Student Heights*
Attachment J, *Answer Key for Student Sheets*
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Attachment A
Pre-Assessment

Name_______________________________ Date__________________________

Directions:
Study the graph below and respond to the questions.

Questions:
1. About what fraction of the day is spent on math?
2. About what fraction of the day is spent on other language arts?
3. On which subject (math, science, social studies, or language arts) is the most time spent?
4. How do you know the answer to these questions even though there are no numbers?

5. Make a graph of the data in the table.

Temperatures for the Month of December

<table>
<thead>
<tr>
<th>Week</th>
<th>Average Temperature in Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>56</td>
</tr>
<tr>
<td>2</td>
<td>65</td>
</tr>
<tr>
<td>3</td>
<td>45</td>
</tr>
<tr>
<td>4</td>
<td>35</td>
</tr>
</tbody>
</table>
1. About 1/5

2. About slightly less than 1/2

3. language arts

4. Sample answers may include thinking about the circles in percentages and then converting to fractions or dividing the circle graph into fractional parts.
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Attachment C
Post Assessment Project

Name_________________________________                    Date____________________

Directions:
1. Conduct a survey on a question that interests you, such as
   • How many hours of television do you watch per week?
   • How many people live in your home?
   • What is your favorite TV program?

2. Organize the results of the survey into a table.

3. Create a stacked graph, line plot or histogram displaying your results.

4. Describe the frequency distribution of a set of data by general appearance or shape.
   • The number of modes
   • Middle of the data
   • Level of symmetry
   • Outliers

5. Analyze the data in the graph and describe the conclusions that can be made from the graph.

6. Collect additional data, modify the graph, and justify new findings.

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<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Analyzes and interprets the data using the graph as support</td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
<td>• Organizes results of the survey into a table</td>
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<tr>
<td></td>
<td>• Includes minor flaws in constructing a graph and interpreting the data</td>
</tr>
<tr>
<td><strong>Intervention Required</strong></td>
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<tr>
<td></td>
<td>• Results of the survey are disorganized in the table</td>
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<tr>
<td><strong>Re-teaching Required</strong></td>
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</tr>
<tr>
<td></td>
<td>• Results of the survey are disorganized in the table</td>
</tr>
<tr>
<td></td>
<td>• Includes major flaws in constructing a graph and interpreting the data</td>
</tr>
</tbody>
</table>
Directions: Study the graphs and answer the following questions.

1. What is the total number of students who participated in this survey?
2. Which sport is the most popular?
3. Which sport is the most popular with sixth graders?
4. Which grade has the most students participating in soccer?
5. Which grade has the fewest students participating in football?
6. What is the average number of basketball players per grade?
7. How is a stacked graph different from a bar graph?
8. How is a stacked graph similar to a bar graph?
At Woodland Middle School, Mrs. Smith asked her students to survey the school and determine the number of students who eat school lunch each day.

Use the following data to create a stack graph. Make sure to label the x-axis, y-axis, title, and legend.

<table>
<thead>
<tr>
<th></th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>5th Grade</td>
<td>30</td>
<td>25</td>
<td>45</td>
<td>45</td>
<td>55</td>
</tr>
<tr>
<td>6th Grade</td>
<td>40</td>
<td>30</td>
<td>50</td>
<td>50</td>
<td>70</td>
</tr>
<tr>
<td>7th Grade</td>
<td>60</td>
<td>40</td>
<td>60</td>
<td>70</td>
<td>90</td>
</tr>
</tbody>
</table>
Directions: Study the graph and answer the questions.

1. How many kids spend 20 minutes or less per week doing chores?
2. How many kids spend more than 80 minutes per week doing chores?
3. What is the most common amount of time spent doing chores?
4. What is the least common amount of time spent doing chores?
5. How is a bar graph different from a histogram?
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Attachment G
Jump Height of Students

Name_______________________________    Date________________________

Mr. Jones, the P.E. teacher, had his students measure how high each student could jump. The students were then instructed to graph their data as a class. Use the information in the table below to create a histogram. Be sure to label the x-axis, y-axis and title.

<table>
<thead>
<tr>
<th>Name</th>
<th>Jump Height (cm)</th>
<th>Name</th>
<th>Jump Height (cm)</th>
<th>Name</th>
<th>Jump Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ann</td>
<td>5</td>
<td>Patrick</td>
<td>29</td>
<td>Vanessa</td>
<td>27</td>
</tr>
<tr>
<td>Saqoya</td>
<td>11</td>
<td>Dave</td>
<td>50</td>
<td>Angel</td>
<td>13</td>
</tr>
<tr>
<td>Kyle</td>
<td>75</td>
<td>Shelby</td>
<td>37</td>
<td>Logan</td>
<td>51</td>
</tr>
<tr>
<td>Ben</td>
<td>55</td>
<td>Seth</td>
<td>14</td>
<td>Shaniqua</td>
<td>54</td>
</tr>
<tr>
<td>Zach</td>
<td>25</td>
<td>Amanda</td>
<td>62</td>
<td>Chantrice</td>
<td>62</td>
</tr>
<tr>
<td>Carl</td>
<td>27</td>
<td>Miles</td>
<td>73</td>
<td>Bob</td>
<td>56</td>
</tr>
<tr>
<td>Abby</td>
<td>6</td>
<td>Simon</td>
<td>10</td>
<td>Sarah</td>
<td>12</td>
</tr>
<tr>
<td>Kurt</td>
<td>62</td>
<td>Lindsey</td>
<td>44</td>
<td>Brian</td>
<td>79</td>
</tr>
<tr>
<td>Andrew</td>
<td>52</td>
<td>Lynzee</td>
<td>14</td>
<td>Maria</td>
<td>29</td>
</tr>
<tr>
<td>Catie</td>
<td>36</td>
<td>Brittany</td>
<td>65</td>
<td>Ella</td>
<td>32</td>
</tr>
<tr>
<td>Kelli</td>
<td>15</td>
<td>Elizabeth</td>
<td>15</td>
<td>Megan</td>
<td>20</td>
</tr>
<tr>
<td>Hoda</td>
<td>53</td>
<td>Vicente</td>
<td>60</td>
<td>Michael</td>
<td>27</td>
</tr>
<tr>
<td>Kaltun</td>
<td>44</td>
<td>Mariya</td>
<td>47</td>
<td>Ross</td>
<td>70</td>
</tr>
<tr>
<td>Victor</td>
<td>13</td>
<td>Irina</td>
<td>33</td>
<td>Gary</td>
<td>19</td>
</tr>
<tr>
<td>Juan</td>
<td>47</td>
<td>Mackenzie</td>
<td>66</td>
<td>Mary</td>
<td>49</td>
</tr>
</tbody>
</table>
Mr. Smith gave the following assignment last week. He told the students to go home and collect any pennies they found laying around the house and bring them in the next day. The students then graphed the number of pennies each student brought in. These are the number of pennies each student collected: 85, 75, 90, 65, 85, 95, 90, 60, 75, 85, 90, 100, 95, 70, 75, 75, 85, 70 and 60.

This is the construction of the graph.

1. How many students collected pennies?
2. What is the largest number of pennies collected?
3. What is the smallest number of pennies collected?
4. What is the range of pennies collected?
5. What was the most common amount of pennies that was collected?
6. What is the median number of pennies collected?
7. What was the average number of pennies collected?
8. What is the distribution of the data collected? Explain.
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Attachment I
Student Heights

Name_______________________________ Date__________________________

In groups of two:
• Use a tape measure to measure the height of your partner to the nearest centimeter.
• Use the table given to record the height of every student in class.
• Create a line plot to represent the height of the students in your class.
• Answer the questions that follow.

<table>
<thead>
<tr>
<th>Student</th>
<th>Height</th>
<th>Student</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Attachment J
Answer Keys for Student Sheets

Attachment D, Stacked Graphs
1. 141 students
2. softball / baseball
3. soccer
4. 6th grade
5. 5th grade
6. 5th grade – 6, 6th grade – 9, 7th grade – 10

For questions 7 and 8, a discussion should include ideas related to the physical appearances of both graphs.

Attachment E, Time for Lunch

![Bar graph showing number of students by day of the week and grade level.]

Attachment F, Histogram
1. 10
2. 15
3. 41-60 minutes
4. 0-20 minutes
5. Answers will vary, however a main difference is that bar graphs are categorical while histograms display the frequency within an interval. A discussion should include ideas related to the physical appearances of both graphs.
Attachment J
Answer Keys for Student Sheets (continued)

Attachment G, Jump Height of Students
Sample Graph:

Attachment H, Line Plot

1. 20
2. 100
3. 60
4. 40
5. 85
6. 80.5
7. Sample answer: The majority of the students collected 85 or more pennies.