Commentary:
Understanding the limitation of graphs is important, as well as understanding the types of graphs suitable for different types of data. Students must have opportunities to analyze and discuss the purposes and limitations of different kinds of graphs. Providing negative examples of graphs and allowing students to explore the problems with those graphs is as necessary as seeing proper examples of graphs.

Pre-Assessment:
- Collect graphs from newspapers, magazines or textbook resources. Make a transparency of each graph.
- Show students a pictograph, bar graph and a line graph on the overhead projector.
- Ask students to write down the type of graph (pictograph, bar or line). Then, ask students one or two questions connected to each graph. The questions should ask students to identify how many or how much of something is represented in the graph or to identify when or where the most or least occurred.
  1. How is the data represented in this graph?
  2. What interval is used on the graph?
- Conduct a discussion about the information available in bar, line and picture graphs.

Scoring Guidelines:
During the class discussion of the graphs, make informal anecdotal records of the students’ understanding. Focus on whether or not the students know the different types of graphs. Also, note if students can read and interpret the different graphs.
Post-Assessment:
This post-assessment is a continuation of the groups’ work in the main lesson beginning with step 10.
- Have students look at the three types of graphs (bar, line and picture) they have created to represent their collection of data.
- Have students work individually to decide which of the three types of graph best represents the data, and have students write a response explaining why that type of graph best represents the data.
- Have each student also write an explanation of why one of the other graphs does NOT represent the data well.

Provide a group of students with another group’s set of interpretation questions to answer in a written form. Students answer these questions individually.

Scoring Guidelines:
Use Selection of Best Graph Post-Assessment Rubric, Attachment A, to assess what students know about how each type of graph.

Instructional Procedures:
Part One
1. Use Three Untitled Graphs, Attachment B, showing only the graphs in the left column, and lead a discussion about how data is represented by a variety of graphs. Discuss how some types of graphs are more appropriate for different types of data, the audience for the results and the purpose in reporting the results. Use some of these guiding questions:
   - What can you tell me about these graphs? (types, missing titles, missing axis labels)
   - What are some questions that might apply to these graphs?
   - What are some advantages/disadvantages when using each type?
   - Which of these could show the average high temperatures in Columbus?
   - Which of these could show the answer to the question posed to a class of third graders, “What is the most common day to be absent?”
   - Which type of graph could show the answer to the question, “How many brothers and sisters do you have?”

2. Uncover the graphs in the right column (cover the top portion) and continue the discussion:
   - How are these graphs different than the ones just shown? (axis labels and graph titles are provided)
   - What are some additional questions that could apply to these graphs?
   - How do the axis labels help the reader interpret information?
   - What does a picture graph need that the other two do not have? (key indicating value of each picture)
   - Why is a key important to a picture graph?
   - The line graph is not a good choice for representing data concerning the number of student absences. Why? (There is no meaning for points on the line between the days of the week. A scatter plot would be a better choice.)
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- What other kinds of data would not be appropriate for a line graph? (Any data that falls into categories, where there is not meaning for between categories. Some examples are colors of jackets worn in the winter, homeroom teacher of students, types of cars owned by families, pets, etc.)

3. Present the following scenario.

Mary wants to invite ten friends to her birthday party and asks them what flavor of ice cream they would like to have at the party. Four of her friends like chocolate, two friends prefer strawberry, one enjoys mint chocolate chip, and three like cookie dough.

a. Ask students which kind of graph they would choose to represent this data and give a reason why they would choose that type.

b. Have the students help create the graph on the chalkboard or overhead.

c. Have students make up questions relating to the graph. (Which type of ice cream should Mary order the largest amount of? How many more friends liked chocolate more than strawberry? Which flavor is the least favorite?)

4. Present the following situation to the students:

Gary planted a bean seed. He kept track of how many inches tall his plant grew. Here is his list: week 1, 2 inches; week 2, 5 inches; week 3, 6 inches; and week 4, 8 inches.

a. Ask students which kind of graph they would choose to represent this data and give a reason why they would choose that type.

b. Have the students help create the graph on the chalkboard or overhead.

c. Have students make up questions relating to the graph.

5. Inform the students know that they will be placed in small groups during the next lesson to complete a task which includes determining a survey question, collecting data, organizing the data into a table, representing the data in at least three different graphic forms and creating interpretation questions for their graphs.

6. For homework, have students make a list of possible survey questions for the small group to consider during the next lesson.

Instructional Tip:
Make clear to the students that this survey question must be able to be answered immediately, not requiring any further research or questioning to answer.

7. Have students respond to the following prompt in writing in their mathematics journals or use Learning about Types of Graphs, Attachment C. Discuss the importance of titles and axis labels for graphs. Also, explain what you know or have learned about the three different types of graphs: bar, line and picture.

Instructional Tip:
Read the students’ journal entries before the next class period to see if any further discussion of the three types of graphs is needed.

Part Two

8. Have several students share their journal entries from the previous day.

9. Place the students into small groups of three to five students. Allow the small groups to share their survey questions from the homework assignment.
10. Interrupt the sharing after about five minutes and lead a class discussion about making the survey questions interesting. This will assist the students in creating a wide variety of questions, rather than the typical “What is your favorite (color, food, pizza topping, etc.)?”
   a. Tell the groups that they have five minutes to decide upon their group’s survey question.
   b. As the groups select their question, write them on the board. If a question is already on the board, it may not be used a second time. This ensures no repetition of survey questions. The question also is written at the top of a class list at the group’s table.

**Instructional Tips:**
- Having a class list of names available helps each group know if someone did not answer the survey question. The students place their answers to the questions beside their own name.
- If the class has a small number of students, consider building in a little extra time to survey another class as well.
  
  c. Take approximately 15 minutes to have all students circulate among the small-group tables answering the different survey questions. The class list with the survey question written on it remains at the group’s table while the students move around answering questions.
  
  d. When all groups are finished collecting data, they begin the task of organizing it into charts, representing it by creating three different graphs (bar, line and picture), and creating three to four interpretation questions about the set of completed graphs. These are displayed on chart paper to make them large enough to be seen easily when posted around the room.
  
  e. Use the rest of the math class to begin work on the charts and graphs.

11. Have the groups complete the **Exit Card**, Attachment D, which lists the tasks the group has completed. Have each student complete a card, but turn them in as a small group.

**Instructional Tip:**
Looking over the cards will help plan how much time to provide to finish the lesson. It may take an extra day.

**Part Three**
12. Have the students sit in their small groups from Part Two of the lesson. Return the exit cards from the previous day to remind students what still needs to be done.

13. Circulate among groups assisting where needed.

14. As groups finish their charts, graphs and questions, post them on the walls around the room to be used during the post-assessment.

**Instructional Tip:**
Check through the interpretation questions created by each group to ensure that they are appropriate for use in the post-assessment.

15. When the groups are finished with their work, have them answer the following self-reflection questions in their journals:
   a. How well did my group work together?
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b. How could my group improve?
c. How did I contribute to the group?
d. What new information did I learn about bar graphs? line graphs? picture graphs?

16. After all groups are finished, the students will be using the group graphs and interpretation questions to complete the Post-assessment activities.

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).

- Provide pre-made forms to create the graphs. These would have blank lines for axis labels and for the title, and, possibly, even the intervals preset.
- If students are having difficulties with creating questions, provide example interpretation questions for them to use when creating the ones for their own graphs.
- Have them investigate and use other types of graphs and plots (e.g., circle, double bar, double line graphs.)
- Have them survey different populations (e.g, kindergarten or fifth-grade students, teacher/staff members, etc.) with the same survey questions. Then, have them create a second set of graphs, interpret the similarities/differences between population responses, and finally, conjecture why those similarities or differences occurred.

Extension:
Encourage students to use their graphing skills to communicate information about your school to others. Examples of such communication could be the variety of lunch menu items throughout the month/year or how many days of absence occur each month. These graphs could then be shared through the daily morning announcements (if they are televised) or the school newspaper.

Home Connection:
Collect real-life examples of graphs from newspapers, magazines, brochures, etc.

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: overhead transparency, a collection of various types of graphs

For the students: chart paper, markers, various sizes of grid paper, math journal
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**Vocabulary:**
- bar graph
- line graph
- picture graph

**Technology Connection:**
Create graphs using graphing software on the computer.

**Research Connections:**


**Attachments:**
Attachment A, *Selection of Best Graph Post-Assessment Rubric*
Attachment B, *Three Untitled Graphs*
Attachment C, *Learning About Types of Graphs*
Attachment D, *Exit Card*
### Group Graphing – Grade Four

**Attachment A**

**Selection of Best Graph Post-Assessment Rubric**

<table>
<thead>
<tr>
<th>Choice of graph for most appropriate</th>
<th>Exemplary Solution</th>
<th>Complete Solution</th>
<th>Adequate Solution</th>
<th>Inadequate Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appropriate graph chosen and <em>detailed</em> explanation given including several reasons</td>
<td>Appropriate graph chosen and explanation given with reasons.</td>
<td>Appropriate graph chosen with limited explanations.</td>
<td>Inappropriate graph chosen OR no explanation for appropriate graph.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Choice of graph for least appropriate</th>
<th>Exemplary Solution</th>
<th>Complete Solution</th>
<th>Adequate Solution</th>
<th>Inadequate Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appropriate graph chosen and <em>detailed</em> explanation given including several reasons.</td>
<td>Appropriate graph chosen and explanation given with reasons.</td>
<td>Appropriate graph chosen with limited explanations.</td>
<td>Inappropriate graph chosen OR no explanation for appropriate graph.</td>
</tr>
</tbody>
</table>
Group Graphing – Grade Four

Attachment B
Three Untitled Graphs

Columbus

<table>
<thead>
<tr>
<th>Month</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg High Temp</td>
<td>20</td>
<td>25</td>
<td>40</td>
<td>30</td>
</tr>
</tbody>
</table>

Number of Students Absent

<table>
<thead>
<tr>
<th>Day</th>
<th>Mon</th>
<th>Tues</th>
<th>Wed</th>
<th>Thurs</th>
<th>Fri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students Absent</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Number of Cars in Taylorville

<table>
<thead>
<tr>
<th>Language</th>
<th>American</th>
<th>Japanese</th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Each car stands for 100 cars
### Group Graphing – Grade Four

**Attachment C**

**Learning About Types of Graphs**

<table>
<thead>
<tr>
<th>Bar Graphs</th>
<th>Line Graphs</th>
<th>Pictographs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Group Graphing – Grade Four

Attachment D
Exit Card

Your Name ____________________________

Group Members__________________________________________________________

<table>
<thead>
<tr>
<th>Task</th>
<th>Completed</th>
<th>Still to do Tomorrow</th>
<th>Questions or Comments About the Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select survey question.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collect data.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organize data into a chart.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make bar graph.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make line graph.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make picture graph.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write 3 to 4 interpretation questions.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other questions or concerns from the group_________________________________________

________________________________________________________________________
________________________________________________________________________