

Short-Answer Question Rubric

| | 2 | 1 | 0 |
|--|---|---|---|
| <p>Explaining & Interpreting your Answer</p> <p>MA.E.1.2.1.5.6 The student analyzes and explains orally or in writing the implications of the data.</p> <p>LA.B.2.2.1.5.1 The student writes notes, comments, and observations that reflect comprehension of fifth-grade or higher level content and experiences from a variety of media.</p> | <p>You explain the implications of the data so correctly and completely that someone else can find the answer. When asked, you make true statements about the given answer.</p> | <p>You explain the implications of the data, but leave out steps that are needed to guide the reader to the correct answer. When asked, you attempt to make true statements about the given answer.</p> | <p>Your explanations and interpretations are incorrect, misunderstood, or not given.</p> |
| <p>What each level means...</p> | <p>A score of two means your explanation shows a complete understanding of the math concepts and critical thinking used in the problem.</p> | <p>A score of one means your explanation shows a partial understanding of the math concepts and critical thinking used in the problem.</p> | <p>A score of zero means your explanation was completely incorrect, not understood, or that you gave no response at all.</p> |

FCAT format adapted from Harcourt Brace & Company: The Math Advantage by Kristy Rousseau

Student Activity Sheet for **Opening the Case**

Detective _____

1. How much time should the average fifth-grade student spend on homework to make good grades? Explain your answer.
-
-

2. Share your response on the chart paper provided.

3. Use your textbook index to find step-and-leaf plot. Organize the results of the girls' portion of the class survey in a stem-an-leaf plot.

4. Define:

mean _____ median _____

mode _____ range _____

5. Use the girls' results from #3 and complete:

mean _____ median _____

mode _____ range _____

6. Complete Detective Diary Entry #2 in your journal. Given the boys' results for our class survey, use a stem-and-leaf plot to organize the information. Determine the range and measures of central tendency from the plotted data. In 2 or 3 sentences, explain how the stem-and-leaf plot helps identify the range, mean, median, and mode from the set of data.

7. Use the index of your textbook to find bar graph, line and circle graphs. Write the purpose of each in the space provided below.

Page ____ bar graph _____

Page ____ line graph _____

Page ____ circle graph _____

8. Write your response to Detective Diary Entry #3 in your journal. Explain the relationship among the graphs and the measures of central tendency (also known as the mean, median, mode and range).

9. Use the Short-Answer Question Rubric to self- and peer-assess your journal entries.

10. HOMEWORK: pages _____

Weblinks completed:

_____ The Party Mode at

<http://www.BeaconLc.org/rousska/ThePartyMode/ThePartyMode.htm>

_____ The Part Comedian at

<http://www.BeaconLC.org/rousska/ThePartyComedian/thepartycomedian.htm>

_____ A Party in Review at

<http://www.BeaconLC.org/rousska/APartyInReview/apartyinreview.htm>

_____ The Mean Green Machine at

<http://www.BeaconLC.org/rousska/TheMeanGreenMachine/themeangreenmachine.htm>

Optional links:

This site is ABSOLUTELY awesome!! It allows students the opportunity to practice using data in a stem-and-leaf plot to find the mean, median, and mode.

<http://www.shodor.org/interactivate/activities/stemleaf/index.html>

This site offers a demonstration lesson for teachers using stem-and-leaf plots.

<http://www.shodor.org/interactivate/lessons/stemlf.html>

This site offers an excellent illustration of a stem-and-leaf plot and allows for interactive practice finding the mean, median, and mode of data using an Online stem-and-leaf plot.

<http://argyll.epsb.edmonton.ab.ca/jreed/compHELP/stemleaf.html>

These sites offer an online math dictionary for educators and students. You want to check these out!!

<http://www.teachers.ash.org.au/jeather/maths/dictionary.html>

<http://www.harcourtschool.com/glossary/math/glossary6.html>

Activity Sheet developed by Gaynell Jones

Vocabulary for Data, Detectives, and Decisions

1. Data - a set of information.
2. Population - and entire group to be examined (including every member of the group). As defined by the "Statistics Glossary" by Valerie J. Easton and John H. McCoy at http://www.stats.gla.ac.uk/steps/glossary/basic_definitions.html , "A population is any entire collection of people, animals, plants or things from which we may collect data. It is the entire group we are interested in, which we wish to describe or draw conclusions about. In order to make any generalizations about a population, a sample, that is meant to be representative of the population, is often studied. For each population there are many possible samples. A sample statistic gives information about corresponding population parameter. For example, the sample mean for a set of data would give information about the overall population mean. It is important that then investigator carefully and completely defines the population before collecting the sample, including a description of the members to be included. Example: The population for a study of infant health might be all children born in the UK in the 1980's. The sample might be all babies born on 7th May in any of the years."
3. Statistical survey - a method designed to collect statistical data about a specific population. Surveys can be designed to answer who, what, when, where, why, or how about a population.
4. Data displays - there are several forms of data displays: tables, line graphs, charts, bar graphs, histograms, and box-and-whisker graphs. A data display is an organized collection of data. Each type of data display has a specific function. A line graph is appropriate to show data that *changes over time*. A bar graph helps to show a comparison between two or more things. The circle graph does a better job of showing percentages and relationships of the "part" to the "whole." A table and a chart are primarily used to organize data in some sort of structure, but do not usually go the extra step to show a relationship between the data. An organized data display includes: reasonable titles, labels, scales, and intervals.
5. Graph - a diagram used to represent data.
6. Line graph - a data display used to show data that changes over time.
7. Circle graph - a data display that is used to percentages and relationships of the "part" to the "whole."
8. Table - a display that organizes data in rows and columns, but does not usually show the relationship between the data.
9. Bar graph - a data display used to show a comparison between two or more things.

10. Stem-and-leaf plot - a data display used to show comparison between data. A stem-and-leaf plot is especially helpful when analyzing data for the mean, median and mode. One reason a stem-and-leaf plot is used is to summarize data in an organized way. A stem-and-leaf plot is like a histogram because it displays the **number of times that an event within a particular range occurs**. However, a plot goes one step beyond a histogram, by showing the **exact** data points. This is helpful when accuracy of the data is necessary for further study. Look at a stem-and-leaf plot below.

| stem | leaf |
|------|------|
| 5 | 244 |

AND

| stem | leaf |
|------|------|
| 27 | 7 |

In the left column we put the *STEM*, which is **ALL EXCEPT** the **LAST** number of each data point. In the right column we put the *LEAF*, or the **LAST NUMBER** of the data point.

In the example above, the numbers represented in the first row are 52, 54 and 54. The number represented in the second row is 277.

To build a stem-and-leaf plot there are several preliminary steps that one must complete. First, identify the data set that will be organized. Arrange the data from least to greatest value. By arranging the data in order of magnitude it is easier to see which numbers occur more than once. Then proceed to place the all except the last number of each data point in the left column (stem), and the last number of the data point in right-column (leaf).

11. Pictographs - a data display using pictures to represent quantity.
12. Charts - a data display that is used to organize data in some sort of structure, but does not usually go the extra step to show a relationship between the data.
13. Representative Sample - a representative part from a larger whole group or population.
14. Statistics - the American Heritage College Dictionary, Third Edition defines statistics as, "The mathematics of the collection, organization, and interpretation of

- numerical data, esp. the analysis of population characteristics by inference from sampling" (Boston, New York: Houghton Mifflin Company, 2000) 1328.
15. Sample - a specific portion of a population (usually consisting of people or objects). As defined by the "Statistics Glossary" by Valerie J. Easton and John H. McCoy at http://www.stats.gla.ac.uk/steps/glossary/basic_definitions.html, "A sample is a group of units selected from a larger group (the population). By studying the sample it is hoped to draw valid conclusions about the larger group. A sample is generally selected for study because the population is too large to study in its entirety. The sample should be representative of the general population. This is often best achieved by random sampling. Also, before collecting the sample, it is important that the researcher carefully and completely defines the population, including a description of the members to be included. Example: The population for a study of infant health might be all children born in the UK in the 1980's. The sample might be all babies born on 7th May in any of the years."
 16. Sample bias - when the METHOD used to acquire a sample RESULTS in a sample that is SYSTEMATICALLY DIFFERENT from the POPULATION it is called a biased sample. Examples of common misuses of probability and statistics include inadequate sample size; incomplete or incorrect graphs; over-generalized results; over-interpretation of numerical data; use of raw data, percents, or statistics (range, median, mean, or mode) to misrepresent the data collected; misrepresentation of the likelihood and significance of a result (see the FCAT specifications provided by the Florida Department of Education at <http://www.firn.edu/doe/sas/fcat/fcatis01.htm> .
 17. Mean - an average, or mean, computed by adding the total of all of the values in set of data and dividing by the number of values in the list (also known as the addends).
 18. Median -- given a set of data, arranges the data from least to greatest in value; find the middle number in the range (if there are an even number of data in the set, take both values and average them), this middle value is the median.
 19. Mode - is the value or values that occur the most often in a set of data.
 20. Range - given a set of data, this value tells us the difference between the highest and the lowest value (extreme).
 21. Measures of central tendency - there are three measures of central tendency: mean, median, and mode. "These terms are used to describe where the CENTER of the data TENDS to fall."
 22. Survey - a detailed investigation.

Special vocabulary used in the grade level expectations for this unit, but not a concept taught in this unit.

23. Histogram - the American Heritage College Dictionary, Third Edition defines a histogram as, "A bar graph of a frequency distribution in which the widths of the bars are proportional to the classes into which the variable has been divided and the heights of the bars are proportional to the class frequencies" (Boston, New York: Houghton Mifflin Company, 2000) 644. Another way to visualize a histogram is a collection of data that is arranged on a coordinate plane with a vertical and a horizontal axis. A histogram shows frequency for a variable within equal intervals. The data on the horizontal axis usually represents the appropriate intervals for the kind of data it represents (in other words, if the data represented the age of humans and there were intervals 150-160+, then there is a problem because no human has ever lived to that ripe old age). The vertical axis usually shows the frequency of the data. A histogram looks like a bar graph, however there are some differences between the two. In a histogram, BOTH axes represent numerical values. However, in a bar graph, either axis can be any variable (Example-dog, Lisa, TV, etc.) and have no numerical value. On a histogram, there is no space between the bars, but in a bar graph there is some separation between the bars. The horizontal axis is usually represented with equal intervals (Example-# 0-9, 10-19, 20-29, etc.); however, in a bar graph there is only a single variable. A histogram can be misleading if there are too many or not enough bars used in the data set. (Note: Histograms differ from bar graphs in that the bar of the histogram represents a range of categories rather than just one category as in the bar graph.)

Compiled List of Detective Diaries for the Entire Unit DATA, DETECTIVES AND DECISIONS

1. Detective Diary Entry #1: Students will read the following scenario before responding to the prompt: Marie believes that students who do between 4 and 10 hours of homework per week make better grades than student who do not do homework or who do more than 10 hours of homework per week. To test her hypothesis, she is designing a survey that she will give the students at her school. Entry 1: "List the *questions* Marie should include in her survey." "Explain in a paragraph how Marie should choose *a sample representative* of the entire school." (This prompt is located in Diagnostic Assessment #1 for the unit.)
2. Detective Diary Entry #2: "Given the boys' results from our class survey, use a stem-and-leaf plot to organize the information. Determine the range and measures of central tendency from the plotted data. In 2 or 3 sentences, explain how the stem-and-leaf plot helps identify the range, mean, median, and mode from a set of data." Make sure students understand these concepts and provide help if students are struggling before moving on to the next diary entry. This entry follows the diagnostic assessment -entry #1-that is described in the unit plan titled, "Data, Detectives and Decisions." DD#2 serves as the formative assessment for MA.E.1.2.2.5.1, MA.E.1.2.2.5.2 and LA.B.2.2.1.5.1 [LP#1].
3. Detective Diary Entry #3: "Explain the relationship between different types of graphs and the measures of central tendency." After responding in their Detective Diaries (entries #2 and #3), students self-and peer- assess these entries using the criteria listed on the Short-Answer Question Rubric. DD#3 serves as the formative assessment for MA.E.1.2.1.5.1 and LA.B.2.2.1.5.1 [LP#1].
4. Detective Diary Entry #4: "How can we find a REPRESENTATIVE SAMPLE of 5th grade students for our survey?" DD#4 serves as the formative assessment for MA.E.3.2.1.5.2 and LA.B.2.2.1.5.1 [LP#2].
5. Detective Diary Entry #5: "What question(s) would you ask in your survey?" DD#5 serves as the formative assessment for MA.E.1.2.1.5.4 and LA.B.2.2.1.5.1 [LP#2]. After responding in their Detective Diaries (entries #4 and #5), students self-and peer- assess these entries using the criteria listed on the Short-Answer Question Rubric.
6. Detective Diary Entry #6: "After collecting the results from the survey of 5th grade students, what are some ways we can display the data that will help us easily identify the range, mean, median, and mode of the data? Based on the results that you collected, what comparisons can be made between student's responses?" DD#6 serves as the formative assessment for MA.E.1.2.1.5.1, MA.E.1.2.1.5.6, MA.E.3.2.1.5.4, and LA.B.2.2.1.5.1 [LP#3].
7. Detective Diary Entry #7: "Use a stem-and-leaf plot to display the data of the representative sample collected by the small groups. Identify the range and measures of central tendency of the representative sample. List 2-3 interpretations and/or statements that can be made based on the data displayed." DD#7 serves as the formative assessment for MA.E.1.2.2.5.1, MA.E.1.2.1.5.6, MA.E.3.2.1.5.4, MA.1.2.2.5.2, and LA.B.2.2.1.5.1 [LP#3].

8. Final Diary Entry: Students will read the following scenario before responding to the prompt: Marie believes that students who do between 4 and 10 hours of homework per week make better grades than students who do not do homework or who do more than 10 hours of homework per week. To test her hypothesis, she is designing a survey that she will give the student sat her school. Final Entry: "***Design a survey*** that would enable Marie to collect the data she needs to make a fair judgment about how much homework is necessary to make better grades. Explain in a paragraph how to administer the survey so that Marie can gather ***a sample representative*** of the entire school." (This prompt is located in Summative Assessment #1 for the unit.)

Key:

LP #_ =Lesson Plan number

[LP #1] = Opening the Case

[LP #2] = Observing the Evidence

[LP #3] = Looking for More Clues

[LP #4] = Using Statistics to Uncover More Evidence

[LP #5] = Closing the Case

INSTRUCTION FOR STEM-AND-LEAF PLOTS:

One reason a stem-and-leaf plot is used is to summarize data in an organized way. A stem-and-leaf plot is like a histogram because it displays the **number of times that an event within a particular range occurs**. However, a plot goes one step beyond a histogram, by showing the **exact** data points. This is helpful when accuracy of the data is necessary for further study. Look at a stem-and-leaf plot below.

EXAMPLE:

| stem | leaf |
|------|------|
| 5 | 244 |

AND

| stem | leaf |
|------|------|
| 27 | 7 |

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To build a stem-and-leaf plot there are several preliminary steps that one must complete. **Step 1:** First, identify the data set that will be organized. **Step 2:** Arrange the data from least to greatest value. By arranging the data in order of magnitude it is easier to see which numbers occur more than once. **Step 3:** Then proceed to place the all except the last number of each data point in the left column (stem), and **Step 4:** the last number of the data point in right-column (leaf).

****If students need more practice with this concept use different data sets and ask students to organize the data in a stem-and-leaf plot. Some hot topics for data collection might be: number of hours spent watching television each week, number of hours spent playing with friends each week, number of hours spent sleeping each week, number of hours spent with family each week, amount of money spent on entertainment each week, amount of money earned from chores, or the number of home runs in a game for a team per season.

Another way students can practice using a stem-and-leaf plot is by organizing numbers into the plot using the steps listed above. It is more meaningful for students if the numbers used are derived from actual data a student would be interested in. So the

numbers might be: 80, 31, 33, 11, 10, 44, 11, 80, 67, 65, 10, 64, 32, 67 (*make sure that the numbers match the 'kind of data' you are collecting...for instance the numbers listed here are not appropriate if the numbers are supposed to represent the number of inches grown in a month).

Step 1: Practice numbers: 80, 31, 33, 11, 10, 44, 11, 80, 67, 65, 10, 64, 32, 67

Possible data source: Number of hours spent playing each week (example: 7 days -Sunday through Saturday)

Step 2: Arrange the numbers from least to greatest.

10, 10, 11, 11, 31, 32, 33, 44, 64, 65, 67, 67, 80, 80

| Step 3 stem | Step 4 leaf |
|----------------|----------------|
| 1 | 0011 |
| 2 | |
| 3 | 123 |
| 4 | 4 |
| 5 | |
| 6 | 4577 |
| 7 | |
| 8 | 00 |

(*Notice the numbers in the stem that were not a part of the original data. These numbers serve as placeholders for the data that exists between the data represented.)

Using data organized in a stem-and-leaf plot, it is then possible to identify the measures of central tendency (mean, median, and mode) and the range.

To find the **Mean** of the data:

1. Add all the numbers together from the data set
($10+10+11+11+31+32+33+44+64+65+67+67+80+80 = 605$).
2. Then divide by the total number of numbers in the data set (14).
3. 605 divided by $14 = 43.214285$. The Mean of the data set is 43.214285 .

To find the **Median** of the data:

Look at the data properly (from least to greatest) arranged in the stem-and-leaf plot.

1. Cancel a number from the top and bottom leaf at the same time. For example, cancel the numbers **10** and **80**.

| stem | leaf |
|------|------------------|
| 1 | 0 011 |
| 2 | |
| 3 | 123 |
| 4 | 4 |
| 5 | |
| 8 | 4577 |
| 9 | |
| 8 | 0 0 |

2. Repeat step 1 until the middle number of the data set is left. This number is the median of the data (*if the total data set has an even number, then there will be two numbers left. In order to find the median in this case, add the two numbers together and divide by 2. The mean of these two numbers is the Median. In the example provided here, there are 14 numbers so we will need the mean of the two middle numbers, which are 33 and 44. Together they make 77 and divided by 2 = 38.5. The Median for this data set is 38.5.

To find the **Mode** of the data:

1. Find the most frequently occurring number(s) from the data set. It is possible to have more than one mode from a set of data. Looking at this data set, the most a number occurs is two times. There are several numbers that occur twice: 10, 11, 67, and 80, therefore all of these numbers are the Mode of the data.

To find the **Range** of the data:

1. Again assuming that the data set is properly arranged from least to greatest, take the highest value in the data set and subtract from it the lowest value. In this example $80 - 10 = 70$, therefore the Range is 70.