



**ARKANSAS
DEPARTMENT
OF EDUCATION**

STEM FOUNDATION 2: Critical and Close Reading of Nonfiction Text

**Lesson Title: Determining the Best
Central Tendency
Mathematics Grade 6
Lesson Plan Handout**

Teacher Created Materials
PUBLISHING

Lesson Title: Determining the Best Central Tendency

Foundation 2: Critical and Close Reading of Nonfiction Text

Mathematics Grade 6

Mathematics Common Core State Standards
6.SP.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
6.SP.3 Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.

Common Core State Standards Mathematical Practices
CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.
CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.
CCSS.Math.Practice.MP6 Attend to precision.

Materials

- *Leveled Text for Mathematics: Data Analysis and Probability*
(average Lexile Reading Level: 910L)
 - What Does *Mean* Mean?
 - Median in the Middle
 - Mode and Range
- *Leveled Math Problems: Level 6, Center It* (pages 118–119)
- *Reading and Writing Strategies for Mathematics*, Semantic Word Map (page 126)
- *Advantages–Disadvantages Chart*
- 2 Spinners
- chart paper

Introduction

1. Tell students that today they are going to learn about central tendencies concepts (mean, median, mode, and range). Each group will be assigned a measure of central tendency on which they will become experts by reading a piece of text on that measure.
2. Share with students the Common Core State Standard. Explain to students that the math objective for today is to learn what each measure of central tendency is, how to calculate the measures of central tendency, and how to determine which measure of central tendency is most appropriate in contextual situations.
3. Have students participate in a brief Think-Pair-Share to answer the following question:
What is the math goal of the lesson today?
4. Display a chart with the steps of close reading.

Introduce the close reading process.

5. Tell students that to learn the measures of central tendency, we are going to go through a process called close reading. Explain to students that when we close read in math, we can learn more deeply the mathematical concepts, skills, and mathematical practices from analyzing the information the author has shared with us. Today as we close read we are going to let the text that we are reading teach us about central tendencies.
6. Explain to students that for the close reading process, we are going to follow three steps.
 1. The first step is reading for key ideas and details. In this read we are going to learn how to read about a mathematical procedure.
 2. The second step is reading for craft and structure. In this read, we are going to analyze the key terms and symbols used to explain the central tendency.
 3. The third step in close reading is reading for integration of ideas. In this read, we are going to, as a class, show information from the text about each of the assigned measures of central tendencies.
7. Group students homogenously into expert groups. Assign each group one of the following concepts of central tendency:
 - Expert Group 1—Mean
 - Expert Group 2—Median
 - Expert Group 3—Mode and Range

Provide each group with the leveled text for their assigned measure. *A specific level of text may be distributed to a group based on their instructional reading level.*

First Reading: Key Ideas and Detail

Purpose:

CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Small-Group and Whole-Class Discussion:

1. Tell students that the reading objective for today's math lesson is following a multi-step procedure when performing a technical task.
2. Tell students that in the text about their assigned measure of central tendency, there is a procedure for how to calculate that measure. Ask students, "What does the term *mathematical procedure* mean?" Have them develop their own definition for a mathematical procedure in their small groups. Explain that a procedure is a step-by step process. Procedures are a key piece of learning and using mathematics.
3. Ask students, "Why are mathematical procedures important to the study of mathematics?" Have students discuss in small groups. Each group should share out one reason why mathematics procedures are important. If it isn't stated, explain to students that a mathematical procedure helps a mathematician be systematic, accurate, and efficient when solving problems. There are many ways a procedure can be read and learned. Tell students that you will show them one way of reading and learning a mathematical procedure.

Model:

4. Model for students how to read a mathematical procedure. First explain the steps for reading a procedure. Have students choral read the steps of procedure as you model this process.
 - a. Step 1: Read the full procedure to understand it.
 - b. Step 2: Read each step and try the example given for that step.
 - c. Step 3: Go back and follow the whole procedure with a different problem. Check off each step as you go.

Guided Practice:

5. Have students read the text. Instruct students to go back to the section of the text with the procedure for calculating the central tendency. They should follow the steps for reading a mathematical procedure with that section.

Assessment:

6. Have students complete the problem at the end of the text using the procedure for calculating a measure of central tendency.

Second Reading: Craft & Structure

Purpose:

CCSS.ELA-Literacy.RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 6–8 texts and topics*.

Model:

1. Tell students they are going to re-read the text for their assigned central tendency to identify mathematical key terms, words and phrases, and symbols that define the measure.
2. Using a sample piece of text, model how to read the text for meaning of a key concept and the related terms, words and phrases, and symbols. Decide on one of the texts students are using as your example. For example, highlight key terms and symbols as it relates to the operations used to calculate the central tendency. Write a label in the margin, “operations for calculating the mean.”
3. Then model how to complete a semantic word map to summarize and analyze the meaning of a mathematical concepts using the key terms and symbols. Categorize and group the key words and symbols that relate to one another.

Guided Practice:

4. Have students re-read the text for their assigned concepts of central tendency. Tell students they are going to summarize and analyze the meaning of their assigned measure of central tendency. They are to use the mathematical key terms, words, phrases, and symbols in the text to create a semantic word map.
5. Have students complete the semantic word map. Conduct a discussion around the meaning of each central tendency integrating the language and symbols acquired from the text into the discourse.

Formative Assessment:

6. Pose the questions like those below and use the structured interaction strategy Number Heads Together to discuss in small-group before sharing out with the whole group.
7. For Number Heads Together, assign each group a letter. Assign each person in the group a number. Label two spinners or two dice with the letters and numbers. Pose the question. Have students in the small groups discuss the questions. Spin/roll the spinner or dice to select a student number. Spin/roll the spinner or dice to then select a group letter. The student with the selected number in the selected letter group should share their group’s response to the question.

Discussion Questions for Number Heads Together

- a. In your own words, what is the definition of your assigned concept of central tendency?
- b. What symbols are associated with your assigned concept of central tendency? How do those symbols relate to the procedure?
- c. What are two key terms related to your concept of central tendency? What is the relationship between those terms?

Third Reading: Integration of Knowledge and Ideas

Purpose:

CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

Small-Group Discussion:

1. Jigsaw groups into heterogeneous groups with a student from each of the expert groups.
2. In their heterogeneous small groups, the experts for each measure of central tendency will explain what their measure is.
3. Each expert will read aloud from their assigned text. They should read the procedure for calculating the measure of a concept of central tendency and model how to calculate it.
4. If necessary, review and practice the procedures for calculating the concept of a central tendency with the whole group.

Modeling:

5. Tell students that they are going to discuss the advantages, disadvantages, and specific contexts for using a central tendency to represent a data set.
6. Ask students where they can find in their assigned text information about the advantages, disadvantages, and specific contexts of when to use a central tendency.
7. Model how to re-read and annotate in a sample text the advantages, disadvantages, and specific contexts.

Guided Practice:

8. Because students are in heterogeneous groups, have each student re-read independently the text for their assigned central tendency. They should annotate on the text the advantages, disadvantages, and specific contexts.

Modeling:

9. Tell students that they are going to complete in their small groups, a table showing the advantages, disadvantages, and specific contexts for when to use a specific concept of central tendency to calculate a data set.
10. Explain how to read the table. Then model how to extract the relevant information from the text and summarize it in the table. An example is completed below.

	Mean	Median	Mode
Advantages	If the numbers are within a close range of one another, the mean may be an accurate representation of the central tendency of the data.		
Disadvantages	If there is an outlier, it may skew the data set.		
Contexts	Using mean to calculate batting average.		

Guided Practice:

11. Provide each small group with a copy of the table above. Have students in small group share the information about advantages, disadvantages, and contexts from their annotated text. Each expert should share the information relevant to their central tendency. The group should summarize the information from the text and record it in the table.
12. Conduct a whole-group discussion of the advantages, disadvantages, and specific contexts for calculating the mean, median, and mode of a data set. Have students justify their answers with evidence from the text.
13. How can range help you understand the three measures of central tendency?
14. Recreate the table above on chart paper to record the group's responses. You may want to provide students with their own copy of the chart to take notes during the discussion or have students create the chart by folding a paper into five columns and four rows.

Assessment:

15. Have each student independently solve a leveled problem from the “Center It” page.
Students will determine which measure of central tendency is most appropriate for the contextual situation. The problems are leveled, so assign students the problem based on their level of mastery of the standard.
16. Pair students who have different problems and have them share their solutions with justification for why they felt that central tendency represented the data set.

What Does Mean Mean?

What did the bar graph say to the line graph?

Basic Facts

Joe spends an average of 1 hour a day on his homework. Ella is about average height. The average snowfall for a certain region is typically seven feet per year.

What is average? **Average** is a way for a single item to establish a general idea about the entire group of data. If you are asked to find the average, you are usually being asked to determine the mean. To find the **mean** of a group of numbers means to find the sum of the numbers and then divide by the number of addends. Finding the mean of a group of numbers is one method for finding a number that represents the entire group.



Strengths and Weaknesses of the Average

Let's investigate examples of average to understand its strengths and limitations.

Example 1: Bernard sells skis in his shop and he needs to sell an average of five pairs of skis per day to earn enough money for his rent. The following chart displays Bernard's sales for the week. Did Bernard average enough sales in order to pay rent?

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
7	4	5	4	6	7	9

$$7 + 4 + 5 + 4 + 6 + 7 + 9 = 42$$

$$42 \div 7 = 6$$

Yes! Bernard did sell enough skis this week.

Analyze the numbers in the list. In this example, does the mean seem to accurately represent the group? Why? Determine another way to represent this group with one number.

Example 2: Shelly is keeping track of how long she skips rope each day. Here is a chart of her results for five days.

Day 1	Day 2	Day 3	Day 4	Day 5
25 min.	27 min.	3 min.	24 min.	26 min.

$$25 + 27 + 3 + 24 + 26 = 105$$

$$105 \div 5 = 21$$

Shelly averaged 21 minutes per day.

Strengths and Weaknesses of the Average (cont.)

In this example, one of the numbers in the group was significantly smaller than the rest. This is an **outlier** because there is a substantial gap between this number and the rest. Look again at the mean and then compare it to the list of numbers in the set. The mean turned out to be considerably smaller than most of the numbers in the set because there is such a distance between the outlier and the other numbers.

Do you still think the mean accurately represents the group? How could we be assured that one single number would not skew the results to affect the outcome?

Finding the Mean

Computing the mean or average of any group of numbers is a two-step procedure. Let us practice by determining the mean for the following set of numbers: 300, 250, 375, 140, 218, 337.

Step 1: Find the sum of all the numbers in the group.

$$300 + 250 + 375 + 140 + 218 + 337 = 1,620$$

Step 2: Divide the sum by the number of addends.

$$1,620 \div 6 = 270$$

The mean of this set of data is 270.

Using Mean in Our Daily Lives

One of the statistics that is monitored for baseball players is their batting average. Batting average is calculated by taking the total number of a player's hits divided by the total number of times at bat. Batting average is not determined in the same way as most means. First, it is written as a decimal so it can be rounded to the nearest thousandth. So, if there was a batter who had been at bat 20 times and had made contact with the ball 10 times, his batting average would be $10 \div 20 = .500$. We say his batting average is 500.



You Try It

Jonas has been keeping track of his points in every basketball game this season. Below is a chart that displays his results. Use this information to determine the mean of Jonas' scores.

Game 1	Game 2	Game 3	Game 4	Game 5	Game 6
24	14	30	23	19	28

Median in the Middle

A **median** is something that is in the middle. On a highway or divided road, the median strip is a section of land that keeps cars going one direction separated from cars going the other way.



Basic Facts

Median is another way for one number to represent a group of numbers. The median is the middle value of a set of numbers. Sometimes it can be a better representative than the mean, or average. Let's investigate the following example.

Mira tests video games for a living. Every day her team tries to find mistakes, or “bugs,” in the code. When they find these mistakes, the engineers can fix them. Here is a chart of how many bugs Mira's team found each day.

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
17	21	15	117	19	20	22

On the 4th day the engineers had tried to fix something, but instead they made some mistakes. That caused a lot of bugs! Mira's team discovered many more bugs than usual. The 4th day's result of 117 bugs is called an outlier in the data. There is a substantial gap between it and the rest of the numbers in the group.

First let us find the mean.

$$17 + 21 + 15 + 117 + 19 + 20 + 22 = 231$$

$$231 \div 7 = 33$$

Does 33 seem to be an accurate number to represent the group? Could Mira say that her team typically uncovers about 33 bugs per day? Most days Mira's team finds far fewer than 33 bugs, but the 4th day skews the results. That means that because the one result is much different than the rest, it distorts the average.

Now let us find the median. The median is the middle number when the set is listed in numerical order. If we list the number of bugs found from least to greatest, it looks like this:

15, 17, 19, **20**, 21, 22, 117

There are 7 numbers, so the middle number is the 4th in the series. In this example, it is the number 20. Does the number 20 seem to be an accurate representation of the group? Could Mira say that her team finds about 20 bugs on a typical day? In this example the median is a better representative of the data than the mean.

Finding the Median for an Even Set of Numbers

Finding the median for an odd number of numbers is simple. You just arrange the group of numbers in numeric order and then find the number in the middle. However, what if there are an even amount of numbers? In that case there are two numbers in the middle. Here are the steps to follow to find the median in an even set of numbers: 102, 114, 125, 100, 99, 116.

Step 1: List the data in numeric order.

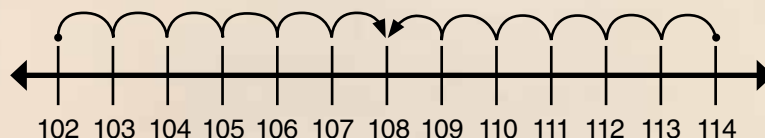
99, 100, 102, 114, 116, 125

Step 2: Find the two middle numbers.

99, 100, **102, 114**, 116, 125

Step 3: Find the number halfway between the two middle numbers. Another way to think of this is that you are finding the mean of the two middle numbers.

108 is the median



$$102 + 114 = 216$$

$$216 \div 2 = 108$$

108 is the median of the set.

Median in Our Daily Lives

Median values are often very useful for understanding data about groups of people. Pretend you are looking at the income of people living in a city. There may be some very wealthy people living in one area, but the remainder of the city is full of people who do not make very much money. Because of the few extreme outliers, the mean income may be quite high. It may appear as though the entire population of the city is well off. However, this is not a very accurate representation of how most people in the city live. In this example, the median value would give you a better idea about most of the people living there.



You Try It

116

Find the median for this set of numbers: 14, 35, 19, 72, 24, 26, 11, 28

Mode and Range

Have you ever ordered pie à la mode? *À la mode* is a French term that means “in the current style or fashion.” Ice cream was popular when the term was first being used, so now *pie à la mode* means “pie with ice cream”! Have you ever sung the song, “Home on the Range”? A range is an immense open region. In mathematics, mode and range have different meanings. However, maybe you will see some similarities as you read.



Basic Facts

Range

In mathematics, the **range** can be thought of as the distance between the least and greatest extremes of a set. Look at this set of data: 1, 5, 7, 10. The range is 9 it represents the difference between 1 and 10. Remember this meaning of range by thinking of it as the big open space between the two end numbers.

Mode

The **mode** is the most frequently occurring number in a set of data. Some sets have more than one mode, while others have no mode. In the set $\{1, 4, 4, 3, 5, 5, 7\}$ there are two modes. The numbers 4 and 5 are both modes of this set because they each occur two times, and twice is the most often that any number recurs in this data set. Remember mode by thinking of a trend that is most fashionable—like having ice cream with your pie! If something is in fashion, more people are following that trend; so if a number is the mode, it is trending more frequently than the others.

Finding the Mode and Range for a Data Set

Let's demonstrate how to determine the mode and the range for a set of data. Monique and her friends intended to analyze the quantities of vegetables they consumed during a school week. Their results are represented in this list: Monique consumed 15 servings; John consumed 17; Jonas consumed 11; Nico consumed 7; Patrick consumed 22; Sasha consumed 17; Geraldo consumed 12; Thanh consumed 23; Kim consumed 20; and Laron consumed 17.

Step 1: Order the data numerically.

7, 11, 12, 15, 17, 17, 17, 20, 22, 23

Step 2: Calculate the range by subtracting the smallest number from the largest number.

$$23 - 7 = 16$$

16 is the range for this set of data.

Step 3: Find the mode by counting how many times each number occurs.

In this case, each number occurs only once, except 17, which occurs three times.

17 is the mode of this set of data.

Mode in Our Daily Lives

In the previous example, we compared the mathematical meaning of mode to something being “in fashion.” Coincidentally, mode is utilized to understand trends relating to sales. Imagine a clothing manufacturer who wants to discover the most popular styles. First they would record each piece of merchandise that they sold and then they would distinguish the specific items with the highest sales rates; this data would provide clear evidence as to the most popular pieces of merchandise at the moment.


You Try It

Nori's wrestling team had a mandatory weigh-in prior to the competition. The competitors' weight distributions in pounds are shown here:


110, 99, 109, 125, 110, 137, 90, 103,
114, 117, 114, 134, 114, 110

Determine the range and mode or modes for this set of data.





Center It

Your basketball coach was bragging to an opposing team's coach about the average number of free-throw shots your team has made this season. If the number of free-throw shots made per player included 17, 13, 7, 9, 10, 15, 14, 11, 16, 18, and 20, should your coach use the mean, median, or mode to make your team look better? Justify your response.


Center It

Your class is competing in the school fitness challenge. You have been recording the number of push-ups each person in the class can do in a one-minute session each day. Today, your class's data included 13, 15, 16, 17, 17, 8, 19, 9, 17, 15, 11, 13, 12, 16, 11, and 13. Should you report the mean, median, or mode of your data to make your class look better? Justify your response.


Center It

Your school's baseball team is traveling to the rival school to compete. In preparation, your coach told the team that the rival school's team batting average is over .300. Did your coach report the team's batting average using the mean, median, or mode, if the individual batting averages are .344, .251, .309, .087, .314, .246, .292, .248, .179, .280, .272, and .314? Justify your response.

Name: _____

Semantic Word Map

A blank concept map template. It features a central white oval with a black outline. Eight black lines radiate from the oval: one straight line pointing vertically upwards, one straight line pointing vertically downwards, and two straight lines pointing horizontally to the left and right. The remaining four lines are diagonal, pointing towards the top-left, top-right, bottom-left, and bottom-right corners. Surrounding the central oval are horizontal lines for writing. There are four lines on the left side, four on the right side, and five lines at the bottom. The entire template is enclosed in a black rectangular border.

Advantages – Disadvantages Chart

	Mean	Median	Mode
Advantages			
Disadvantages			
Contexts			