

## Mean vs. Median

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### Lesson Overview

During the lesson, students explore mean and median with heights of their class. Using their data, they determine which is the best, either mean or median, to answer the question they are investigating.

### Standards Addressed

CCSS 6.SP.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots

CCSS 6.SP.5c Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

### Disciplinary Literacy Best Practices

Wait Time

Agreement Circles

Look Back

Quick Write

### Lesson Plan

Time Required: Two or Three 60-Minute Class Periods

Disciplinary Vocabulary: measures of central tendency, mean, median, average

Materials Needed:

- cash register tape
- paper
- pencil
- watch with a second hand (to help track wait time)

Assessment: Exit Ticket, Student Dialogue in Agreement Circles, Graphical Representation and Quick Write

## Engage

- Inform students that you'd like to hang new coat racks in the classroom but you certainly do not want to hang them too high or too low. So, today, you need to determine what the mean and median height is for everyone so that you could figure out the best height to hang the coat racks. (OR create a similar situation where knowing the average height of students is advantageous for you!)
- In order to do this, the class needs to design an investigation that will answer our question: what is our class mean and median height and which one will provide us with the best data to hang coat racks for everyone and why? Today it is MEAN vs. MEDIAN! (Or...will there be a difference?)
- To get students thinking about mean, ask to think first if they have ever heard anyone refer to "averages". Wait 3-5 seconds before calling on students to allow everyone time to recall where they have heard that term. More than likely, many may refer to grades and sports averages; although, there are many more they have been exposed to (daily rainfall, weight, cost, plant growth, temperatures, etc.)!
- Once there are sufficient responses, inform students that in math, the mean, median (and mode) are specific types of averages or measures of central tendency. And all of those measures (mean, median, and mode) are computed differently. In order to explore any of them though, what must we first do? (measure our height!)
- The class will need to come to a consensus on whether to measure in centimeters or inches. One easy way to measure height would be to first measure using cash register tape and then use the tape with a yard stick or meter stick (depending on which unit of measure the class uses) at a later point. Everyone determines their height by using the cash register tape.

## Explore

- Once each student has the measure of his/her height, inquire about how we might use the tapes to find out the average height of our class.
- One way might be to first pair into smaller groups and find an average of the smaller group (of 3 or 4) to practice before moving to the larger class size. By using the cash register tapes, in smaller groups, students could tape them together (end to end, with no lengths written at first) and then use the combined strip. Students would then determine how to evenly distribute or fold sections of the longer tape now so that they are dividing it into equal sections. (This method demonstrates the process of dividing without doing the calculations, at first.) Each student would need an equal amount of tape.

## Explain

- Once small groups have solved this part, bring the class back together and pose a few questions (allowing for 3-5 seconds wait time between each question in order to allow students time to think):
  - How could we use this same idea in a larger class? (Using the tape would be too much for students...it would be a really long piece of tape!)
  - How could we find out the length our strip would be if we were to put all of them together just as we did in our small groups? (measure each individual length and then add them all together)
  - Then, once we put it all together, how would we distribute that amount equally? (it is distributed or divided among each person...so it depends on the number of people in the group or class)
- This round of questioning should bring them to putting all of the different lengths together to find the total and the equally dividing them among each person to find that average – the mathematical process of finding the mean. Find the mean, as a class, if this is the first time students have been exposed to mean.
- Introduce students to median, which is also an average or measure of central tendency and is the middle value in a set of numbers (which should always be ordered least to greatest!). Unlike the mean, the median is easier to compute and is not affected by one or two extremely large or small values within a set of data.
- Now that the students have determined what their height is, have them (physically) line up in numerical order from least to greatest and begin folding the line in so that they are able to see how to find the median.
- Once the median is determined, go back to the original question: now that we have the mean foot and the median foot for our class, let's go back to our original question we needed to answer: what is our class mean and median height and which one will provide us with the best data to hang coat racks for everyone and why?
- We've answered what is our mean and median height. Now we need to answer: which one provides us with the best data to hang coat racks for everyone? Why?
- To do this, have students stand in a large circle around the room. They are going to participate in Agreement Circles. If they agree that the mean gives the best data to hang coat racks for everyone, then they move to the center of the circle. If they disagree (and think that the median gives the best data) then they remain in the outside circle. Match students up (depending on the number inside vs outside). This could be pairs, one to two, one to three, one to four, two to three, two to four, etc.

- Provide a few minutes for each small group to defend/justify their reasoning. While in discussion, it is possible for students to be convinced to move to another part of a circle. This is okay if it is mathematically justified. You do not want students moving to other parts of the circle because everyone else is doing so. Call time after providing adequate dialogue time for students. Have everyone return to a large circle and talk about what their thinking is. Which one is the best measure for your purpose? Why?
- Prior to students leaving, have them complete an exit ticket using a “Look Back” format.

What I Learned	How I Learned It

- For each item written on the left side of the table for what was learned, the corresponding part for how the student learned it should go on the right side. Both should match. This exit ticket should be given to you as they leave class.

### Extend

- Have students use their height data and create a graphical representation that would best represent their data. Which would they choose: box plot, dot plot, or histogram? Why would they choose this graphical representation? This question could be answered on the back of the graphical representation by using a quick write. Students turn over and quickly write a mathematical justification for choosing either a box plot, dot plot, or histogram.

### Teacher Reflections and Biographical Information

Students are often just told how to find the measures of central tendency and directed when to use each one. Students should be given different situations and determine which of these measures best communicate information in the given situation. Students need to look at each measure and determine how they compare to each other. Students should also be able to determine which measure best represents the data with the respect to the context in which it is presented. This standard lends itself for students to apply reasoning skills to determine which measure or measures best represent the data as well as communication skills to explain and defend the reasoning used. Each of the measures of central tendency has strengths that make it a better choice to represent a set of data in various situations. Students should learn to select the most appropriate average to describe a typical item or a data set. After investigating how each measure of central tendency is affected by the distribution of the data, students can make more informed decisions about which average to use for a given purpose.

- For sets of data with no very low or very high numbers, mean works well.
- For sets of data with a couple of points much higher or lower than most of the others, median may be a good choice.
- For sets of data with many identical data points, mode may be a better description.

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\*NOTE: A portion of this lesson was adapted from an activity titled “The Mean Foot” in *Elementary and Middle School Mathematics Teaching Developmentally: The Professional Development Edition for Mathematics Coaches and Other Teacher Leaders, 8<sup>th</sup> Ed.* (2013) Van de Walle, Karp, & Bay-Williams. Pearson.