

What's the Data All About?

Strand:	Probability and Statistics
Topic:	Describing and determining mean, median, mode, and range of a set of data
Primary SOL:	5.17 The student, given a practical context, will <ol style="list-style-type: none">describe mean, median, and mode as measures of center;describe mean as fair share;describe the range of a set of data as a measure of spread; anddetermine the mean, median, mode, and range of a set of data.
Related SOL:	5.16

Materials

- Linking cubes (or counting chips, square tiles, or any other small item)
- Sticky notes
- Calculators

Vocabulary

arithmetic average, data, data set, fair share, mean, measures of center, median, mode, range

Student/Teacher Actions: What should students be doing? What should teachers be doing?

Note: Students will encounter many new vocabulary words as they move through this lesson. Use the [Vocabulary Word Wall Cards](#) at the VDOE Office of Science, Technology, Engineering & Mathematics website to create a word wall by posting each card as a term is introduced.

1. Explain to students that when planning a mathematics lesson, a teacher needs to make sure there are enough manipulatives for every student in the class. Tell students that for today's lesson, you had to think, "If every student in this room needs to grab a handful cubes from this bag with one hand, about how many cubes would a fifth-grade student be able to grab?" Explain that the class is going to do an experiment and collect data to help the teacher decide about how many a fifth-grade student will grab.
2. Have each student grab a handful of linking cubes from the bag, and record the number of cubes each grabbed on their sheet and on a sticky note. Ask students to make a tower with their cubes and to come to the board and record their number a horizontal list of numbers. Ask students to look at the list, and to predict how many cubes most fifth-graders would grab. Have students share some ideas and why they choose that number. Explain that mathematicians have developed some ways called *measures of center* to make decisions about what a good number is to represent a set of data, and today we are going to look at those ways.
3. The first thing we need to do is organize the set of data from least to greatest. Bring your cube tower and sticky note with the number of cubes and line up from least number of cubes to greatest number of cubes. The student with the smallest number of

cubes is first in line starting at the left. Then continue lining up shoulder to shoulder in numerical order.

4. Students should line up in front of each other when they have the same number of cubes making a human line plot. When students are lined up, ask them to help you make a line plot on the board. Draw a number line on the board, starting with the least number to the greatest number and with ticks equidistant apart, counting by ones. Draw an X for each number the student is holding to complete the line plot. Review the elements that must be included in a line plot. Ask: “How many X’s are there, and is that the number of students?” “Why are there two X’s at some points?” Point to an X and ask, “How many cubes did this student draw?”
5. Ask the first and last students in the line to raise their hand. Ask the class, “In terms of the data, what is special about each of these students?” Lead the group in a discussion of range. Define *range*—the distance between the highest and lowest values—and explain that range is determined by finding “the difference between the largest and smallest pieces of data.” Ask students what the range is for their set of data. Write “Range” on the board, and then record the number sentence on the board. Ask students how knowing the range is helpful.
6. Ask students whether finding “the middle number in a group of data that is arranged from smallest to largest or largest to smallest,” or *median*, might help find the center of the data. Have the students discuss how to find the middle, or median, of their data. Students take the hands of the students beside them and then spread out and form one long line. Then have the first person and last person in the line sit down. Continue this process until there are one or two people left standing. If there is only one person left standing, have him hold up his sticky note and record this as the class median. If two people are left standing, have them use their cubes to find the number exactly in the middle of their two stacks. This will be the median. Record median on the board under the range.
7. Ask students whether finding “the number that occurs most often,” or the *mode*, might help find the center of the data. Lead students to discover that the number with the *most* students will be the mode. There may be some numbers with the same number of students, other than one, and in that case there is more than one mode. Record the number(s) as the mode of the class data under the range and the median.
8. Discuss *mean* and how the concept of *fair share* was used to determine the mean. Help students understand what the *mean* of a set is, using the total amount within the data set and redistributing or dividing it so that each person has the same amount. So now we need to do something so that everyone has the same number of cubes. Encourage students to talk about ways they could find the mean using the cubes. Have students use the concept of fair share by “sharing” or “dividing” and linking cubes with each other until they all have the same number of cubes. If there are not enough for each person to get a whole cube, talk about leftovers and about what part of a cube each person could get. Describe this number as an example of mean, fair share, and division. When the cubes have been shared or redistributed, write the mean on the board under range, median, and mode.

9. At this point, continue to discuss mean as fair share and make explicit how students may have used division to find out how many cubes each person would receive as a fair share. Use the term *arithmetic average* as another way of describing the mean. Have students reflect on the activity and see whether they can determine the mean using arithmetic. When reflecting, have the students think about what they actually did with the cubes to physically solve for the mean by using fair share. Students can use the data generated from the activity, recorded on sticky notes, and graphed. They may be able to generate a procedure that determines the arithmetic mean. The arithmetic is found by adding all numbers on the line plot graph or the sticky notes and then dividing by the number of students participating in the activity.
10. Have students go back to their seats, take out a clean sheet of notebook paper, and turn it horizontally. Fold the sheet into fourths so there are four columns. Write the following words, one per column; Range, Mode, Median, and Mean. Record the values from the activity and then write how each was determined in the appropriate column. In the columns for mode, median, and mean, students should write measures of central tendency. When everyone is finished, facilitate a class discussion to review the process for finding each and what it tells about the set of data. Develop some understanding of why mean, median, and mode are referred to as measures of center.
11. Tell students that a new student is coming in tomorrow, and ask the students what number of cubes would the new student *most likely* draw. Let the students discuss this and share how they arrived at their prediction.
12. Next, reach in and pull out a handful of cubes. Tell the students how many you pulled out, and ask whether they think including the new number of cubes will change the range or measure of center and mean, median, and mode, or measures of center. Give students time to find the new data (range, mode, median, and mean). Use this task to review each of the four terms, their definitions, and how each was used in this experiment.

Assessment

- **Questions**
 - What are some reasons mean, median, and mode are referred to as measures of center?
 - How are mean, median, and mode different?
 - How do we find the range of a set of data?
 - Why is mean called “fair share” or “division”?
- **Journal/writing prompts**
 - From the experiment, explain in your own words the differences between mean, median, mode, and range. Use the numbers to help you describe each.
 - Your teacher is working on your nine-week report card grade. Your grades are 88, 85, 92, 88, and 95. She gave you the choice of having her use mean, median, or mode to calculate your grade. Explain which would you prefer, and why.

- **Other Assessments**

- Pedro said mean is more accurate when representing the center of the data than median. Is he correct? Give an example.
- There are 10 houses in the subdivision. On Monday, the numbers of letters delivered to the houses were 0, 2, 5, 3, 34, 4, 0, 1, 0, and 2. Calculate the mean, mode and the median of the number of letters delivered Monday, and show your work. Determine which number best represents the number of letters the typical house got on Monday. Explain why the ones you did not pick are not good measures.

Extensions and Connections (for all students)

- Show the class grades of a recent test in the form of a stem-and-leaf plot. Ask students to find the mean, median, mode, and range of the data.
- Have students keep track of the number of hours they use a device for each day for a week. Figure the mode, mean, median, and range of these data. Do the measures of center vary? If they vary greatly, extend the project for 30 days.
- Give each student a small pack of round, colored candies. Make a table of data for various colors of candy in their packages. Have students find the mean, mode, range, and median for each color.
- Have students construct paper airplanes, throw the planes a given number of times, and record the distances the planes fly. Then have students find the mean, mode, median, and range for the data.
- During PE, have students record the number of times they can jump using a jump rope within a minute. Repeat and record for at least five times. When they return to class, students find the mean, mode, range, and median of the jumps.

Strategies for Differentiation

- Some students may need to continue to use linking cubes to find the range, mean, median, and mode.
- Prepare a set of index cards with the procedure for finding the range, mean, median, and mode, one card per term. Write the steps of the procedure on one side and a solved problem on the other side. Put the index cards on a ring so that students can refer to it when they forget what to do.
- Help students remember the differences between the measures of center with the following ideas and visuals:
 - *mean* people are “MAD”: Mean-Add-Divide
 - *mode* = most: the amount that occurs the most; *mo* begins both words
 - *median* = middle (the **d** falls in the **m**iddle of median)
 - *range* = biggest – smallest