# What Does Average Look Like?

## Summary
This lesson will help students understand the concepts of range, median, mode, and mean through the use of graphs drawn from models.

## Materials

    Chart paper
    Markers/colored pencils
    Connecting colored cubes
    Flat squares of paper the same size as the cubes (This will be used to represent "0")
    Math journals (lined paper)
  - *Vocabulary Matching Cards*

Additional Resources

Book

  - *Navigating through Data Analysis and Probability in Grades 3-5*
   , by Peggy A. House; ISBN 0-87353-521-9

## Background for Teachers

Many students can calculate the range, median, mode, and mean of a set of numbers. But if asked what that looks like, students have difficulty expressing these concepts. This lesson will help students understand the concepts of range, median, mode, and mean through the use of graphs drawn from models. Students will use manipulatives to represent data that they have collected within groups. By using models, students can compare the differences between mode, median, and mean. Students should understand that the mean, median, and mode are just different ways of calculating what the "middle" is in a set of data. The range will be represented visually as students arrange their models from smallest to greatest. As students show a representation of the mean, the teacher can lead a discussion on the meaning of what the remainder represents. Depending on the students' background knowledge, the teacher can either have the students disregard the remainder or model how the remainder can be represented in fraction or decimal form.

## Intended Learning Outcomes

2. Become mathematical problem solvers.
4. Communicate mathematically.
5. Make mathematical connections.
6. Represent mathematical situations.

## Instructional Procedures

Invitation to Learn

Display a set of objects such as various sizes of crayons on the overhead. Ask the students if they can tell what the average length is in the set of crayons. "Who can draw a picture on the board of what an average looks like?" "When do we use averages?"

Instructional Procedures

    Tell students that they are going to learn four key math words today (range, median, mode, and mean) and that they will draw pictures about these words.
    Hold up the *Vocabulary Matching Cards* . Read the words and their definitions to students.
    Explain that these terms will be used during the day's activities.
    Discuss how graphs and charts represent data that was collected to answer a question

(purpose). Explain that you need a question to answer before you can begin to collect data. As a class, come up with a simple question for students to answer with a number that is between 0-10.

Possible questions:
    How many TV's are in your home?
    How many pairs of shoes do you have?
    How many times have you been to Disney Land?
    How many hours a day do you read?

Display the question on the board.

Put the students into groups of three, five, or seven. This will make it easier to calculate the median.

Pass out 10 like-colored cubes per student and assign each student in the group a different color. Pass out 1 flat square to each student to use as a "0" if needed.

Tell students that they can use the cubes to make a tower that shows their answer to the class question. Have students in each group compare their answer (tower) with the others in their group. Have each group line up their towers in order from least to greatest.

Teach the concept of range. Tell the students that the highest tower is the maximum number in their set of data and that the shortest tower is the minimum number in their set of data. To find the range, they need to subtract the minimum from the maximum. Have each group calculate the range for their set of data. Refer back to the vocabulary definitions used at the beginning of the lesson. Have each student draw a picture of their group's towers (this should look like a bar graph) in their math journals. Have them write the equation that represents the range and an explanation of how they calculated it.

Ask students how many in their group have the same size tower. Explain that if they do, this is he mode. (Refer back to the vocabulary cards.) Have students draw a picture of the mode on their journals and give an explanation of how they calculated it. (The teacher should explain that groups could have more than one mode.)

Have the students line their towers up from least to greatest again. Explain that the middle tower represents the median. Have students draw and explain this in their journals. (This part of the activity is optional because this is not an assessed concept in the 5th grade.)

To teach the mean, ask students if all of them have the same size tower. Ask them how they would find the "average height" of their towers. (Many will be able to explain how to calculate it using paper pencil or a calculator.) Demonstrate how to show the average height of their towers by moving blocks until all the towers are the same height. Have them set the leftover blocks aside until you are ready to discuss remainders. (Give them time to manipulate their blocks.)

Explain that the remainder would have to be divided up evenly among the towers to make them truly even. This requires splitting wholes into parts. Have students estimate how much of each remaining block would need to be added to each tower to make them even. Demonstrate on the board using either decimals or fractions what that looks like.

Explain that an average is a way to "even" things out, and that all the towers should be the same size in their groups. Have students draw and explain this in their journals as before.

Have each group come up with their own questions to use to calculate the range, mean, mode, and median. Let them draw charts representing their data in their journals and share their results with the class.


## Extensions

Students who have a difficult time writing may dictate their explanations to the teacher or another person and have them record it in student's journal next to the illustrations.

Using the scientific method, have students create experiments where the data can be graphed using bar graphs, and the mean, median, range, and mode can be calculated.

Family Connections

Have the students measure each member in their family and record the results. Use the information in a daily activity where students calculate the mean, mode, median, and range for the heights. Ask the students if they can tell by the data the age of the family members as it applies to range.

## Assessment Plan

Students will be able to show understanding of the terms mean, mode, median, and range by:
Using their cubes to model the data they have collected in their groups.
Drawing their models in their journals using markers or colored pencils. They should have four illustrations--one for each vocabulary word/concept.
Having a written explanation next to each illustration explaining how they calculated the data.
Median is not a concept that needs to be assessed in the 5th grade; however, it relates directly to understanding mean, mode, and range in a set of data.

## Bibliography

Research Basis

Lappan, G., Fey, J., Fitzgerald, W. Friel, S. & Phillips, E. (1996). *Data about us*. Connected Mathematics Project, Palo Alto, CA.
"The mode, median, and mean are kinds of averages that are a part of representations and statistics used to analyze data." Students need to understand each of these measures and how they are applied and calculated. This article examines two ways in which the concept of "mean" can be demonstrated.
Hitch, C. & Armstrong, G. (1994). Daily activities for data analysis. *Arithmetic Teacher. 41*(1) 242-245.
"Children develop mathematical concepts by seeing them in a variety of settings." For students to understand statistics and graphs, they need exposure to the process of collecting, organizing, and describing data. This article describes useful activities that help students understand and display data.

## Authors

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