Civil Air Patrol's ACE Program

Statistically Speaking
Grade 6 Additional Rocket Football
Drug Demand Reduction
Manipulative Item Lesson

Topic: measures of central tendency (mean, median, mode, and range) (math)

Length of Lesson: 60 minutes

Objectives:

- Students will order numbers from least to greatest.
- Students will calculate the mean of a data set of numbers.
- Students will find the median of a data set of numbers.
- Students will find the mode of a data set of numbers.
- Students will calculate the range of a data set of numbers.

National Standards:

Next Generation Science Standards:

- Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

***CCSS* Math:**

- 6.SP.B.5.C Summarize numerical data sets in relation to their context, such as by: 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.

Background Information:

Statistics is the practice or science of collecting and analyzing numerical data in large quantities, especially for the purpose of inferring proportions in a whole from those in a representative sample. Thus, in this lesson, you will be exploring how math is an important component in scientific investigation. (The Crash Course in Statistics video may be good to use as an introduction.)

Scientific investigation, engineering, and teamwork are all essential to the success of space exploration. The International Space Station serves as an indispensable laboratory in preparing for future human space exploration. The research completed aboard the ISS is

leading to discoveries in medicine, materials, and fundamental science that will benefit people all over the world. Statistics and probability are math skills needed by researchers in their work, but NASA also uses statistics to analyze and report on how the ISS is used.

"The ISS Utilization Statistics Brochure shows the number of research and educational investigations conducted as part of the space station program. The ISS NASA insert is an overview of U.S. research and educational investigations…(which) reflects activities of NASA and the ISS National Laboratory." These reports break down and compare the various scientific fields in which experiments and research are conducted on the ISS; how many are conducted by the various partners, such as ESA or JAXA; and even in which journals the results were published. The stats are presented through various types of infographics, such as tables, maps, and pie charts. Sharing these details helps the public understand the widespread benefits of the space program, including the number of education and outreach activities per state.

Today, using the simple *Rocket Football* item provided by CAP, students will use math to make a scientific investigation. The question they will be answering is, "How far can a rocket football be thrown by the average 6th grader?" To conduct this investigation, the students will be calculating the number of "student steps" a rocket football can be thrown. They will create a data set from this accumulated data and find the mean, median, mode, and range of this set of numerical data.

But, first, students will need to understand how to use the *Measures of Central Tendency:* mean, median, mode, and range.

- A **measure of central tendency** is a single value that attempts to describe a set of data by identifying the **central** position within that set of data. As such, **measures of central tendency** are sometimes called **measures of central** location. They are also classed as summary statistics.
- To find the **MEAN**, the average of all numbers, add all the numbers and divide by how many numbers you have.
- To find the **MEDIAN**, the middle number, order the numbers from least to greatest then find the middle number. (If there is an even amount of numbers in the list, the middle pair must be determined, added together, and divided by two to find the median value.)
- To find the **MODE**, determine the most frequent number seen in the data. (If there are no repeated numbers, there is no mode. If there are several repeated numbers, there are several modes.)
- To find the **RANGE**, how spread out your data is, subtract the smallest number from the largest number.

Materials:

- notebook paper and pencil
- calculators (optional)
- dry-erase board/chalkboard and marker/chalk
- rocket football (provided by CAP to students)

Lesson Preparation: Take the students to a large open area, such as the gym or outdoors. Designate a starting line from which all students will throw their *Rocket Footballs*.

Lesson Presentation:

1. Ask students if they have considered a career as a scientist. Tell them that most people think being a scientist is all about science, but today, they are going to learn how math is a very important part of being a scientist.

2. To conduct today's lesson, the students must know how to order numbers from least to greatest, and, how to add, subtract, multiply, and divide numbers.

3. Explain to students that scientists spend time researching projects that will lead to discoveries in medicine and materials that will benefit people all over the world. These scientists use math skills to calculate trends in experiments that are being conducted or to determine variables in their projects.

4. Tell the class that they will begin to obtain some numerical data using their 6th grade educational item from CAP- the *Rocket Football*. Students will practice finding the mean, median, mode, and range of all the throws they will make. (Show quick instructional video on An Average Video: Mean, Median, Mode and Range, if desired.)

5. Explain to students that they will each throw their *Rocket Football* from a designated line and then count the distance of their throw using normal steps (neither small nor giant steps). After retrieving their *Rocket Football*, students will go to the teacher (or designee) to record the number of steps it took to reach the football. The teacher or designee will keep this list to take back to the classroom.

6. When back in the classroom, the teacher (or designee) will write all the numbers across the board. The students will copy these numbers onto their paper at their desks to create their data set. They will then do the following steps as directed by the teacher.
   a. The students will put the numbers into order from least to greatest on their paper.
   b. The students will find the median of the data set. If there is an obvious middle number (with an odd number in the data set), the median will be easy to locate.

If there is an even amount of numbers in the data set, the middle pair must be determined, added together, and divided by two to find the median value.

c. The students will find the mean of the data set by adding all the numbers and dividing by how many numbers they added.
d. Students will find the mode or modes, as the number or numbers they see the most. (There can either be NO modes or several modes, depending on the data set.)
e. Students will find the range, which will be the largest number minus the smallest number.

7. After everyone has completed analyzing the data, allow students to check their work using a calculator. (optional)

8. Have a class discussion on what information was found using these measures of central tendencies. Ask how having such information could be helpful to them as researchers. (Students may come up with answers, such as: the rockets may need to be lighter to travel farther; 6th graders have different step sizes/lengths so this may not be a valid test, or, most 6th graders had a similar sized step so this would be a valid test; the rockets should not be advertised to fly farther than a certain length; etc.)

Summarization:
Review the processes of finding the mean, median, mode, and range of a set of data. Have the students tell of other things that could be measured by using these measures of central tendency. Have students tell how being able to analyze data can lead to future career opportunities. Discuss some careers that use statistics, such as a meteorologist or market analyst (including possible associated salaries). The class may also look at how statisticians work within various industries.

Character Connection: Tell students that in life, we need to collect important information before we make decisions about things. Ensuring information is correct allows us to make informed decisions and actions. Using incorrect information can lead to bad choices and/or failed projects or relationships with others due to false conclusions. Thus, before making decisions or sharing information, ensure the information is correct. In other words, seek the truth and speak the truth.

Assessment:
- teacher observation
- student data analysis sheets at desks

Additional activity ideas to enrich and extend the primary lesson (optional):

- Work with the class to complete the "Mad Scientist Math Skills" worksheet to practice finding the measures of central tendency.
- Have the students watch the following videos, the 10 Best Inventions of all Time 5 Inventions That Changed Our World, and the Top 5 Inventions That Changed the World. Have them determine if there are any modes in these three videos.

- Have students work in small groups to look through the newspaper (or watch the news) for examples of statistics (weather forecast, sports section, etc.) and share them with the class.

- Have students research scientists that have used or are using math and science in their quests to develop new technologies, inventions, or discoveries. They could use the The Famous People website and click on profession/scientists and filter- to find interesting scientists in history.

- Have students write a letter to a famous inventor asking this person how using math and science skills help them on their career path.

- Allow students to design an invention of their own or someone else's and describe the invention to the whole group. Have them explain what data they need to prove to others their invention would be useful.

Additional Resources:

- "Improving Human Welfare in 2013 International Year of Statistics" (video)
- The World of Statistics (poster)
- "Statistics - Introduction to Statistics" (video)
- "An Average Video | Mean, Median, Mode, and Range" (video)
- Calculate Mean, Median, Mode, and Range (interactive game)
- Dunk Tank!: Mean, Median, Mode & Range (PBS interactive game)

Mad Scientists Math Skills

NAME _____

1.Each student will call out his/her age as the teacher points to each, in turn. List the ages of students in the room to make your data set, below. Then, follow the directions for the next steps.

Data Set:_____

Order:_____

Mean:_____ Median:_____

Mode:_____ Range:_____

Name 2 things you learned about this data:

_____

_____

2.Each student should count the number of times their eyes blink in a 30-second period. The teacher will say when to start and when to stop. Write the students' responses to make your data set, below. Then, follow the directions for the next steps.

Data Set:_____

Order:_____

Mean:_____ Median:_____

Mode:_____ Range:_____

Name 2 things you learned about this data:

_____

_____