**Lesson Planning Template**

**COSMOS EDUCATIONAL TOOLKIT:** Statistics & Probability in real life

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| **Grade/ Grade Band**: 6th Math  | **Topic:** Data collection and Analysis  | **Lesson #** 1 **in a series of** 1 **lessons** |
| **Brief Lesson Description**: This lesson provides students with an opportunity to identify and apply median, mode, range, and mean using the COSMOS toolkit. Students measure the CO2, humidity, and temperature of two seperate locations over a week long period using the COSMOS toolkit. By conducting this experiment, students develop a strategic approach to organizing data. Students will use this hands on experience to understand the relationship between numbers in a data set through the calculation of median, mode, mean, and range. in the final/next step of the experiment students learn to analyze data from tables and find ways to interpret and represent their data. * This project is directly related to the COSMOS testbed because it uses transmission of data from sensors to an interface using wireless signals. In addition, students will be introduced to the concept that the testbed can be used to create remote wifi networks to collect and visualize data. Therefore, in the future the testbed can be used to gather data in realtime at a larger scale.
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| **Specific Learning Outcomes: Students will be able to** 1. develop a strategic approach to organizing data.
2. investigate what it means to find the mean, median and mode.
3. Use the COSMOS Toolkit to collect data to analyze
	1. Student record the temperature, humidity, and CO2 levels for 7 days
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| **Narrative / Background Information**  |
| **Prior Student Knowledge Required:** Introduction to mean, median, mode, and range is an important concept to help build the students foundation for higher levels of statistics and data analysis. In previous classes students learned that they could analyze data to make predictions. This is called “Data Analysis”. Data analysis is used in business, science, and public sector to enable organizations to make more-informed decisions and to verify or disprove theories and hypotheses. For example, data analysis can help us predict who will become president of the United States or what will be the population of the U.S in 2030! Students are already familiar with the following terms Mean, median, mode, and Range.  |
| **Problem Solving Practices (Ex: Standards for Mathematical Practice):** 1. [CCSS.Math.Content.6.SP.B.5.c](http://www.corestandards.org/Math/Content/6/SP/B/5/c/) -- 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.
2. [CCSS.Math.Content.6.SP.B.5.d](http://www.corestandards.org/Math/Content/6/SP/B/5/d/) --Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.
 | **Main Content Ideas:** * It helps to teach students to understand the meaning of median and mode to middle and range.
* The range is not an average but a measure of spread.
* How data analysis is used to make decisions in everyday life.
* Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.
 | **Possible Multidisciplinary Concepts:** The experiment can be conducted in collaboration with Science teacher **:** How to conduct a controlled experiment. 1. Pose a Testable Question.
2. Conduct Background Research.
3. State your Hypothesis.
4. Design Experiment.
5. Perform your Experiment.
6. Collect Data.
7. Draw Conclusions.
8. Publish Findings (optional).
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| **Possible Preconceptions/Misconceptions:**There are many colloquial words that are used for the idea of average, such as 'typical' or 'common' or even the word 'average' itself. The mean, median and mode are the three averages, or measures of centre, that the lesson focuses upon. * Students tend to confuse the median, mode and mean averages.
* The range is often incorrectly thought of as a type of average.
* Students find it difficult to calculate the median average from data presented in a frequency table.
* measures of central tendency alone may be insufficient to truly describe the typical data in a set. It is possible that two data sets can have the same mean, but be very different kinds of sets. It is best to use measures of central tendency, along with other observations of the data set, to best describe the data set.
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| **LESSON PLAN – 5-E Model**  |
| **ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:** * How many snaps do you send each day/week?
* How many hours of Tv do you watch each day?
	+ How did you come up with that number?
	+ How might your number vary compared to your friend's?
	+ Why might someone's number/value be very high? versus someone with a very low number?
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| **EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:** 1. COSMOS Toolkit that includes---Temperature sensors (thermometer), CO2 Sensor, humidity sensor
2. [Challenge Box and Whisker Plot](https://docs.google.com/document/d/1EumT51JQLXIiTQeACzltL68E3MCLMMkSZiYD-v44axg/edit?usp=sharing)
3. [Vocabulary word worksheet](https://docs.google.com/document/d/1EumT51JQLXIiTQeACzltL68E3MCLMMkSZiYD-v44axg/edit?usp=sharing)
4. [Classwork worksheet](https://docs.google.com/document/d/1y-ray2YPpcBUtvxCJeMgp25ZGq_8FnRNhGMbDxemx-A/edit)
5. [Data Collecting Sheet](https://docs.google.com/document/d/1zb8wN6t9DiFWQurMViO-RF2fjDcjM4-JrTfSTpPKtv0/edit)
6. [Instructions on using the ToolKit to collect data](https://docs.google.com/document/d/1W37A-M4X-SUmJ-nz5GhM0Ar8AAmKV3fgTWhAxFgPUZw/edit)
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| **EXPLAIN: Concepts Explained and Vocabulary Defined:** **Key Vocabulary:** * 1. **Mean** :The "Mean" is computed by adding all of the numbers in the data together and dividing by the number of elements contained in the data set. Example: Data Set = 2, 5, 9, 3, 5, 4, 7 Number of Elements in Data Set = 7, Mean = ( 2 + 5 + 9 + 7 + 5 + 4 + 3 ) / 7 = 5
		1. Note: When we say “average” we usually refer to mean, However, for mathematicians, mean, median, and mode are all measures of average.
	2. **Median** :The "Median" of a data set is dependant on whether the number of elements in the data set is odd or even. First reorder the data set from the smallest to the largest then if the number of elements are odd, then the Median is the element in the middle of the data set. If the number of elements are even, then the Median is the average of the two middle terms. Examples: Odd Number of Elements Data Set = 2, 5, 9, 3, 5, 4, 7 Reordered = 2, 3, 4, 5, 5, 7, 9 ^ Median = 5 Examples : Even Number of Elements Data Set = 2, 5, 9, 3, 5, 4 Reordered = 2, 3, 4, 5, 5, 9 ^ ^ Median = ( 4 + 5 ) / 2 = 4.5
	3. **Mode** :The "Mode" for a data set is the element that occurs the most often. It is not uncommon for a data set to have more than one mode.
	4. **Range** : The "Range" for a data set is the difference between the largest value and the smallest value contained in the data set. First reorder the data set from smallest to largest then subtract the first element from the last element.Examples : Data Set = 2, 5, 9, 3, 5, 4, 7 Reordered = 2, 3, 4, 5, 5, 7, 9 Range = ( 9 - 2 ) = 7
	5. **Quantitative measures**: Data that can be quantified by counting or measuring.
	6. **Qualitative data** is descriptive information (it *describes* something)
		1.
	7. **Measures of center**: describe a set of data by identifying the central position of the data set
	8. **Variability**: how spread out a group of data
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| **ELABORATE: Applications and Extensions:** Students who understand the content can complete the challenge (see attached sheet “Challenge Box and Whisker Plot) **Extension questions** 1. What are commonly used measures of central tendency? What do they tell you?
2. What do measures of central tendency indicate?
3. Which of the following measures of center is not affected by outliers?
4. How do variance and standard deviation measure data spread? Why is this important?
5. Which measure of center is the only one that can be used with data at the nominal level of measurement?
6. How do you make a box-and-whisker plot, and what does it tell about the spread of the data?
7. Which graphic display shows the least detailed information?
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| **EVALUATE:** **Formative Monitoring (Questioning / Discussion):** 1. When adding numbers to find the mean, does it matter the order in which they are added?
	1. No, addition is commutative; the data can be added in any order.
2. How does the mean change if you add a number to the data that is exactly equal to the mean? Explain.
	1. It does not change. Possible explanation: If you add a number greater than the mean, the average is greater. Add one that is less, the mean is less. So, add the same number and the mean remains the same.
3. Why do we need multiple measures of central tendency
4. What do the median, mode, and range tell us about a set of data?

**Summative Assessment (Quiz / Project / Report):** After the activity, the students will take a quiz that will determine if they are able to identify which measure of central tendency most accurately represents a data set. The quiz also requires the students to state an appropriate question based on what kind of numbers are in the data set. see attached document  |
| **Elaborate Further / Reflect: Enrichment:** 1. What were some of the most interesting discoveries I made while working on this project? About the problem? About myself? About others?
2. How well did I and my team communicate overall?
3. What were some things my teammates did that helped me to learn or overcome obstacles?
4. How will I use what I've learned in the future?
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