**LESSON PLAN OUTLINE- Secondary Mathematics Version**

1. TITLE OF LESSON: *Footprints Lab in Discovering Z-Score*
2. CONTEXT OF LESSON: Students just learned how to calculate the mean absolute deviation and the standard deviation but without the use of a formal formula. They also conceptually understand about dispersion from the mean, which is exactly what they will need to discuss z-score.

LEARNING OBJECTIVES and ASSESSMENT:

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| Learning Objective | Bloom | Assessment (Formative/Summative) |
| Students will calculate z-score | Apply | Formative: Correct answers on lab sheet |
| Students will draw conclusions in real-world contexts based on z-score | Understand | Formative: Thoughtful responses on lab sheet. Peer discussions. |
| Students will master calculating mean absolute and standard deviation. | Remember | Formative: Correct answers on lab sheet |
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1. RELATED 2009 VIRGINIA STANDARDS OF LEARNING: A.9 The student, given a set of data, will interpret variation in real-world contexts and calculate and interpret mean absolute deviation, standard deviation, and z-score.
2. MATERIALS NEEDED: Yard stick, Footprints Lab Sheet, rulers for students
3. PROCEDURE: In the table below, include a DETAILED description of each step of the lesson, including description of the mathematical tasks to be used. Write what you will SAY and DO. This should be explicit enough that any substitute could pick up your plan and know exactly what to do. In addition, record what you anticipate the students to do at each step of the lesson. This should include their expected behavior, possible solution strategies to solve the given tasks, anticipated responses to teacher questions, questions they may ask the teacher, and instances where they might struggle.

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| Time | Mathematical Tasks to be Used,  Teacher Thoughts/Actions/Questions | Anticipated Student Comments, Questions, Actions, and Strategies |
| 15 min | BEFORE: Create groups of 2-3.  Warm up: Students will create a vocabulary word map for “deviation.” *Deviation* will go in the center and in each of the corners they will need to provide a definition, a synonym, a sentence and a picture.  How something spreads out from the center  Moves away, difference, divergence, variation  The car deviated off course as to not hit a deer. | Students may not know the definition. They must write down what they think it is or what it could be and then look it up in the dictionary. They should not erase their first definition.  Students may have a hard time with a picture, but simply encourage them to think of their sentence to help them draw a picture. Ask a neighbor to read them their sentence to help them get ideas. |
| 30-45 min | DURING:  “Are there any CSI or Law and Order fans out there?”  Ask that student to read the intro to the lab. Row by row, students will get their foot measured, with their shoe on. Ask one student to write down the measurements on the chalkboard while the teacher measures the feet.  Help students create a good line plot with evenly spaced tick marks.  Students are then to get into the pre-assigned groups to begin working on the Footprints lab.  Remind students that the chart is only there to help them, but their calculator does most of the work.  “Which values are absolutely necessary to write down?”  “Let your calculator do the work!”  Teacher circulates classroom listening to discourse and conversation in groups. Teacher will try to provide hints, encourage their ideas, and observe interactions and discussions.  If there is a group that finishes rather quickly, teacher will go over lab with them, asking for further information/explanation as needed. If they have proven mastery, they can answer questions for other groups. | Students are to write down the measurements of all classmates under #1.  Data points, sum of last column, MAD, stdv. |
| 15-25 min | AFTER:  Choose selected questions to discuss.  “What sort of definitions did you use for mean absolute and standard deviations?  “How many of you had trouble answering question #11? Why?” So z-score allows us to find the exact amount away from the mean, in terms of standard deviation.  Do some additional z-score calculations, both estimating and then finding the exact value, as needed.  Ask for comments to questions #14-16.  Ask students to line up according to z-score, and then compare heights. (To make it less chaotic, find the student with the largest or smallest foot and work down.) Can the class make any generalizations based on what they see?  Students will turn in their lab sheet and rulers.  Final After: Two Word Strategy  With a partner, discuss what were the most important words we have used these past two days?  As a class, share the words that came up. Teacher will write them on chalk board.  Individually, each student will pick two words and write down why they think they are the *most* important. | “My foot size didn’t fall on an exact deviation. But I knew it had to be between +1 and +2 deviations away from the mean.”  “Can you find z-score using MAD?”  Students will come to front of the classroom.  Students will briefly discuss in pairs.  Class discussion.  Students are working alone. |

1. MEETING THE NEEDS OF ALL STUDENTS: Choosing the groups appropriately is crucial. Assisting some students by spatially organizing their dot plot may be necessary.
2. WHAT COULD GO WRONG WITH THIS LESSON AND WHAT WILL YOU DO ABOUT IT? They may not think about the answers and just ask the teacher for help. I’m hoping that they will be cooperative and try. If not, I could try mixing up a few groups. Bring the students up to the front of the classroom to line up according to z-score could be disorganized and chaotic.
3. CONNECTION TO CTA: I adapted and changed this Footprints lab, which I have used before, as a follow up to the Raisin Lab. I wanted to incorporate vocabulary help, as that was discussed a lot at CTA. The vocabulary word map is a CRISS strategy that I believe someone mentioned at CTA. Dan Mulligan suggested the Two Word Strategy, which I thought would work really well here after two heavy days of statistics. I am also trying to plan the TAPS strategy into all of my lesson plans.

