Topic: Wet Landing:
Airplane Statistics and Landing Input

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Genre: Math & Science **Unit: Statistics and Probability**
Grade Level: 6th - 8th grade **Duration: 1-2 single periods**

Essential Question
(Domain 1: Planning and Preparation-Component 1c: Designing Coherent Instruction)

- How do we input data of an airplane landing on a wet runway?
- How do we interpret and graph the data of an airplane using the wet runway scenario?
- How can various weather and weather patterns affect the landing of an airplane on a runway?

Background Knowledge

Background Summary:

This would be the first lesson conducted out of a series of 2 with 4 activities. Students will have prior knowledge on how to find the mean, median, mode and range of a given set of data. Students with previous robotic lessons have the knowledge of how to sync and run programs from the brick, collect data, analyze it, and draw conclusions. We have seen this used throughout all the robotic lessons as well as classroom lessons thus far.

In this unit students will be examining and interpreting a flight landing scenario. Students will watching a video clip of an airplane landing on a wet runway and making observations on the video in their groups. From this students will be given their own scenario to then model the robot to. Students will be syncing their robot with a manual and automatic flight simulation movement on a wet runway and recording their data. Students will find the central tendency and create a scatter plot diagram as well as find a line of best fit and write an equation. From this students will create a quantitative analysis report as an engineer studying the landing of an airplane on a wet runway. They will present their report to the class in a role play setting.

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Lesson Objective:

- Students will be able to plot points on a graph..
- Students will find the mean, median, mode and range from a set of data.
- Students will be able to draw conclusions about the velocity of moving objects in the same direction based on data input and analyzed.
- Construct and interpret scatter plots to investigate patterns of association between two quantities.

Standards
(Domain 1: Planning and Preparation- Component 1a:Demonstrating Knowledge of Content and Pedagogy)

Connection to Common Core Math Standards

Statistics and Probability:

6.SP Develop understanding of statistical variability.

1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers.
2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
3. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.

Summarize and describe distribution.

4. Display numerical data in plots on a number line, including dot plots, histograms, and boxplots.
5. Summarize numerical data sets in relation to their context

7.SP Use random sampling to draw inferences about a population.

2. Use data from a random sample to draw inferences about a population with an unknown characteristic of interest.

8.SP Investigate patterns of association in bivariate data.

1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities.
2. Know that straight lines are widely used to model relationships between two quantitative variables.
3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

Science NGSS Standards

MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Science MST Standards:

Standard 7: Interdisciplinary Problem Solving

Key Idea 1: The knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science/technology/society, consumer decision making, design, and inquiry into phenomena.

Vocabulary **(Domain I: Planning and Preparation - Component 1e: Demonstrating Knowledge of Students.)**	**Prep Work/Materials** **(Domain 1 Planning and Instruction- Component 1e: Designing Coherent Instruction, Domain 3 Instruction- Component 3c: Instruction Engaging Students in Learning)**	**Cross Curricular Connection** **(Domain I: Planning and Preparation - Component 1a: Demonstrating Knowledge of Content and Pedagogy, Component 1b: Demonstrating Knowledge of Students.)**
Clusters Positive association Negative association Linear association Non linear association Slope y-intercept Central Tendency (mean, median, mode, range) Linear Function Non-linear Function Distance Domain scatter plot line of best fit outliers prediction average Speed Ultrasonic sensor input output Simple Machine	Lego mindstorm kit and program Lego mindstorm robot with ultrasonic sensor and touch sensor notebook pencil tape measure computer calculator SMART Board	Math Science Technology English/Language Arts

Differentiation
(Domain I Planning and Preparation-Component 1e: Designing Coherent Instruction, Domain 3: Instruction - Component 3b: Using Question and Discussion techniques Domain 3: Instruction - Component 3c: Engaging Students in Learning)

- Visual: computer simulation
- Auditory: Lecture and Class Discussions
- Verbal: Worksheets
- Kinesthetic: robot activities, active participation
- Students will be working in small groups 3-4 per groups

Procedure: (Domain I Planning and Preparation-Component 1e: Designing Coherent Instruction, Domain 3: Instruction - Component 3b: Using Question and Discussion techniques Domain 3: Instruction - Component 3c: Engaging Students in Learning)	Student Engagement (Teacher Assessment)
Introduction/Do Now: **https://www.youtube.com/watch?v=jb_kvzsuZWU** -Students will view the YouTube video and make observations of the airplane landing in their notebooks. -Students will discuss their findings with the class. -Students will complete part 1 of data analysis and statistics worksheet. -Teacher will introduce the scenario students will be using to conduct their data collection. **Scenario:** United Airlines has been having trouble with landing their planes properly on the runways. They also have problems because their planes fly into both tropical areas with wet runways and dry desert areas. This wetness causes their planes to shake when landing, sometimes out of control. You have been hired as an engineer and mathematician to explore this climate effect, and also to see if it would be better to install an automatic braking system on the plane once it hits the runway. Let the floor in the classroom represent the runway and the robot represent the airplane after it hits the runway. -Teacher will discuss with students scientific reasons and record on a graphic organizer made on chart paper. -Teacher will discuss the scenario with the class and explain their roles: ● Teacher will explain the purpose of the light sensor and the touch sensor. ● Teacher will explain where students will get their readings from. She will explain that students need to have a 5-6 feet distance from the wall as a starting point. ● Students will break up into groups of 3-4 and run 3 trials for each distance noted on their worksheet for wet manual landing simulation first. NOTE: Students are going to have to go into both simulation and adjust the seconds after each run through. ● Students will each take a turn within their group and place the robot on the starting point. ● Students will start the right program on the brick. ● Students will hold down and walk with the touch sensor for the appropriate amount of seconds stated on their data collection worksheet. Students will record their data.	

• Students will then remove the touch sensor and sync the wet auto landing simulation. • Note on wet auto landing: Some of the automatic landing scenarios land faster than others (3,4,5 seconds). Explain why there may be this variance of automatic landing in wet conditions, such as that the automatic system may have to compensate for varying wetness or iciness. • Students will run that program taking turns within their group and record findings. • Students will input their data on their data collection worksheet and begin to calculate for the mean, median, mode, and range. • Students will then complete their worksheet by graphing their data into a scatter plot diagram and finding the line of best fit. • Teacher will be walking around the room to check for understanding. • Students will revisit the video and discuss the correlation between the video observations and the computer generated simulation.	
Assessment *(Formative or Summative)* **(Domain 1 Planning and Instruction- Component 1e: Designing Coherent Instruction, Domain 3 Instruction- Component 3c: Engaging Students in Learning, Domain 3 Instruction- Component 3d: Using Assessment in Instruction)**	**Student Engagement (Teacher Assessment)**
Homework/Extension: Students as engineers will write a quantitative analysis to submit to their boss on their findings as to why landing on a wet runway is not smooth. Students will also incorporate their scientific reasons as to why this is. Can weather conditions play a role? What if the runway was covered with ice? Human timing? Include all your data in your report. Quiz - worksheet	
Additional Resources	
https://www.youtube.com/watch?v=jb_kvzsuZWU - airplane landing on wet runway	