WAMC Lab: Marble Roll Data Collection (Linear)
Math Concept(s): Linear Line of best fit
Source / Text: Dana Texas Center
Developed by: **Phaedra Hazelton** E-Mail: **phazelton@centralia.wednet.edu** Date: 6/26/2024

Attach the following documents:

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

Short Description (Be sure to include where in your instruction this lab takes place):
Students will drop a marble in a PVC pipe at different heights and calculate the time at which the marble reaches the end of the pipe.

Lab Plan
Lab Title: Marble Slide

Prerequisite skills: rate, slope y-intercept
Lab objective:

- Students will gather data & record data to determine function relationships
- Students will interpret and make inferences from functional relationships.
- Students will determine whether given situations can be represented by linear functions.
- Students will translate among algebra, tables, and graphical representations of linear functions.
- Students will solve problems using student collects and organizes data, makes decisions and critical judgements.

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*
Mathematics K–12 Learning Standards:

- **HSF-BF.A** Build a function that models a relationship between two quantities
- **HSF-IF.A** Understand the concept of a function and use function notation
- **HSF-IF.B** Interpret functions that arise in applications in terms of the context
- **HSF-IF.C** Analyze functions using different representations
- **HSF-LE.B** Interpret expressions for functions in terms of the situation they model

Standards for Mathematical Practice:

MP1 Make sense of problems and persevere in solving them.

MP2 Reason abstractly and quantitatively.

MP3 Construct viable arguments and critique the reasoning of others.

MP4 Model with mathematics.

MP5 Use appropriate tools strategically.

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

RI.9-10.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

K-12 Science Standards

HS-PS2-2 Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

HS-PS2-1 Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

Technology

-

Engineering

-

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION
Creativity and Innovation
☐x Think Creatively
☐ Work Creatively with Others
☐x Implement Innovations
Critical Thinking and Problem Solving
☐x Reason Effectively
☐ Use Systems Thinking
☐x Make Judgments and Decisions
☐x Solve Problems
Communication and Collaboration
☐x Communicate Clearly
☐x Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS
Information Literacy
☐x Access and Evaluate Information
☐x Use and manage Information
Media Literacy
☐ Analyze Media
☐ Create Media Products
Information, Communications and Technology (ICT Literacy)
☐ Apply Technology Effectively

LIFE & CAREER SKILLS
Flexibility and Adaptability
☐ Adapt to Change
☐ Be Fxlexible
Initiative and Self-Direction
☐ Manage Goals and Time
☐ Work Independently
☐x Be Self-Directed Learners
Social and Cross-Cultural
☐x Interact Effectively with Others
☐x Work Effectively in Diverse Teams

Productivity and Accountability
☐ Manage Projects
☐x Produce Results
Leadership and Responsibility
☐x Guide and Lead Others
☐x Be Responsible to Others

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials

Pencil, Data worksheet, PVC pipe about 8 feet long, stopwatch, meter stick.

Set-Up Required:

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Students will be able to communicate with each other by asking a question and answering questions.

Cooperative Learning:

- Students will work in groups of 3-4 to collect data of the marble slide.
- If there are ML students, the students can be paired to collect the data from their question with another ML student whose English skills are better.

Expectations:

- Students will have data to be able to analyze in an extension lesson.

Timeline:

- 45 minutes of collecting data of various heights of PVC pipe and collecting the time to reach the end of the pipe.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- Students learn how to collect data and record the data.
- How can this data be analyzed with what we have previously learned? "Central tendencies", can a graph be used to represent this data? How would the student go about analyzing the data to make a statement about the classroom's data from the question.

Career Applications

- Any career which requires individuals to work with others, accurately measure data, and to make inferences of the given data.

Optional or Extension Activities

Name: _____ Date: _____ Period: _____

Marble Slide Lab

Objective: Students will collect data of the marble sliding down a PVC pipe at different heights, marbles dropped in the hole distance, and time in seconds it takes to reach the end of the pipe.

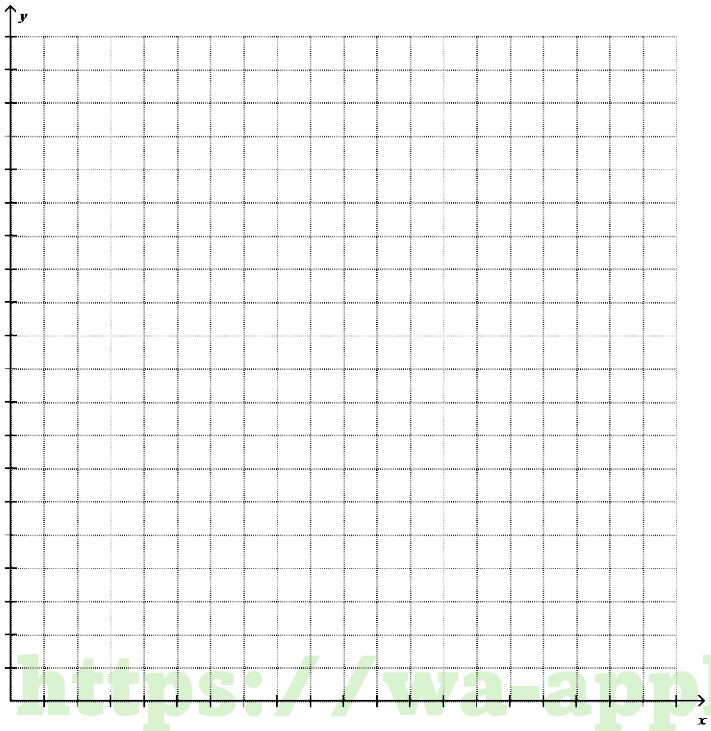
Job Descriptions:
Measure: Measures the distance from ground to pipes elevation, distance marble is dropped
Timer: times when the marble is dropped until it reaches the end of the pipe in seconds
Recorder: person who records the time in seconds, height the pipe is off the ground the distance the marble is dropped from the pipe.
Quality Controller: person who oversees the rest of the group members to make sure the jobs are executed correctly, steps in when group members are absent or if other groups in the class need assistance.
All students will answer the questions on the lab sheet.

What is the relationship between the length of the pipe and the time the marble reached the end of the pipe?

Roll the marble at a fixed height off the ground for all 5 rolls. Place the marble in 5 holes (2m, 3m, 4m, 5m, 6m) different holes then record the time it takes for the marble to reach the end of the pipe for each drop.
What is the fixed height off the ground?

Time (Seconds)						
Hole distance (meters)						

Graph the data making sure to label the axes and to give the graph a title.



Estimate the rate of change of distance vs. time for each and then find the average.

Draw of line of best fit. Name two points along the best fit line. Point 1: _____ Point 2: _____

Estimate the y-intercept.

Find the slope given the two points along the line.

State the real-life context of the slope and write the units for slope.

Write a point slope equation.

Convert the point slope equation to slope y-intercept form. Show work.

What is the y-intercept?

How close is the estimated y-intercept from the calculated y-intercept? Explain.

What is the real-life context of y-intercept?

Use the trend line/line of best fit to determine the length of marble drop if the time is 40 seconds. Show work.

Use the trend line/line of best fit to determine the time of marble drop if the marble is dropped 10 meters from the end of the pipe. Show work.