WAMC Lab Template

Math Concept(s): Stopping Distance, V=D/T

Source / Text: 4-3

Developed by: Michael Vowels E-Mail: mvowels@psd1.org Date: _____Summer 2023_____

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):

Lab Plan

Lab Title: Stopping Distance

Prerequisite skills: Students should have basic knowledge of the V=D/T equation as well as basic arithmetic skills.

Lab objective: Students will be able to calculate real time stopping distance data using their reaction time and the velocity of a pull back car

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*

Mathematics K–12 Learning Standards:

- F-IF Interpret functions that arise in applications in terms of the context.
- S-ID Summarize, represent, and interpret data on a single count or measurement variable.

Standards for Mathematical Practice:

- 1. Make sense of problems and persevere in
- solving them.
- 2. Reason abstractly and quantitatively.
- 3. Construct viable arguments and critique
- the reasoning of others.
- 4. Model with mathematics.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.
- 7. Look for and make use of structure.

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

- CCSS.ELA-LITERACY.SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

K-12 Science Standards

- HS-PS2. Motion and Stability, HS-PS3. Energy

Technology

- 5. Computational Thinker. Students develop and employ strategies for understanding problems in ways that leverage the power of technology

Engineering

- Students collect data or identify relevant data sets, use digital tools to analyze them and represent data in various ways to facilitate problem solving and decision making

Leadership/21st Century Skills:

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

- [x] Global Awareness
- [x] Financial/Economic/Business/Entrepreneurial Literacy
- [ ] Civic Literacy
- [x] 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
- [x] Work Creatively with Others
- [x] Implement Innovations

Critical Thinking and Problem Solving
- [x] Reason Effectively
- [x] Use Systems Thinking
- [x] Make Judgments and Decisions
- [x] Solve Problems

Communication and Collaboration
- [ ] Communicate Clearly
- [ ] Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS

Information Literacy
- [ ] Access and Evaluate Information
- [ ] Use and manage Information

Media Literacy
- [x] Analyze Media
- [ ] Create Media Products

Information, Communications and Technology (ICT Literacy)
- [x] Apply Technology Effectively

LIFE & CAREER SKILLS

Flexibility and Adaptability
- [x] Adapt to Change
- [ ] Be Flexible

Initiative and Self-Direction
- [ ] Manage Goals and Time
- [ ] Work Independently
- [x] Be Self-Directed Learners

Social and Cross-Cultural
- [ ] Interact Effectively with Others
- [ ] Work Effectively in Diverse Teams

Productivity and Accountability
- [x] Manage Projects
- [x] Produce Results

Leadership and Responsibility
- [ ] Guide and Lead Others
- [ ] Be Responsible to Others

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

Materials

- Computers
- Paper for data collection
- Stopwatch
- Pull back car (available at dollar store)
- Tape

Set-Up Required:

- Put pieces of tape around 12 inches wide, 5 feet apart from each other to represent a starting and stopping point

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Students are split into groups of 2

Cooperative Learning:

- Students split into groups of 2. 1 of the students goes through the reaction time simulator at https://faculty.washington.edu/chudler/java/redgreen.html. Once they're done, they work on calculating the speed of the pull back car. One student pulls the car back and lets go while the other uses the stopwatch to calculate the time and then speed.

Expectations:

- Students should be able to calculate the velocity of the pull back car, their average reaction time and then the average stopping distance of a vehicle traveling the speed of the pull back car.

Timeline:

- This should be an hour long lab. 30 minutes for calculating data and 30 minutes for answering follow up questions.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- Improving driving skills, understanding risk assessment

Career Applications

- Engineering, Insurance Adjusting, Transportation/Freight driving

Optional or Extension Activities

- We could scale it up to actually use the speed of real cars. Try and calculate cars on the road (from a safe distance) by using the same method of timing the passing of a given distance.

Stopping Distance Lab Instructions

Materials:

Pull Back Car (available at Dollar Store)
Stopwatch
Laptop
Worksheet

Step 1: Ensure that you have all of your materials.

Step 2: 1 person will go to https://faculty.washington.edu/chudler/java/redgreen.html and follow the prompts test your reaction time. Write down the average of 5 attempts on the corresponding worksheet.

Step 3: At the pull back car track, Person A pulls the car back to the starting line while Person B prepares the stopwatch.

Step 4: Person A lets go of the pull back car and Person B starts the stopwatch. Once the car passes the finish line (5 feet away) Person B stops the stop watch and writes down the time. Repeat this process 5 times, and find the average time it took the car to travel 5 feet.

Step 5: use the V=D/T formula to calculate the **average velocity** in Feet/Second

Step 6: use the V=D/T formula to calculate how far the pull back car would travel during your average reaction time. This number is your **reaction distance.**

Hint: V= average velocity T= reaction time. Find D

Step 7: use the $s^2/20$ formula to calculate **braking distance**.

Hint: S= Velocity IN THIS LAB ONLY

Step 8: Add the reaction distance to the braking distance to find total **stopping distance**

Calculation Worksheet:

Reaction Time	
T1	
T2	
T3	
T4	
T5	
Average T	
Average V (D=5)	
Reaction Distance	
Braking Distance ($s^2/20$)	
Stopping Distance	

Reflection Questions:

Divide your Average V by 1.467 to convert your cars speed to miles per hour:

1. Is your pull back car driving fast compared to how fast a real car travels?

2. If you react more slowly, what happens to reaction time?

3. If reaction time increases, what happens to stopping distance?

4. What might be some things that may slow down your reaction time while driving?

Stopping Distance Lab Rubric:

Complete Data Table

4 PTS – Completed all of my measurements
3 PTS – Completed most of my measurements
2 PTS- Completed some of my measurements
1 PT- Completed a few of my measurements

Calculation of reaction distance, braking distance and stopping distance

4 PTS- Completely accurately calculated reaction distance, braking distance and stopping distance
3 PTS- Mostly accurately calculated reaction distance, braking distance and stopping distance
2 PTS- Sometimes accurately calculated reaction distance, braking distance and stopping distance
1 PT- made a few questions

Follow up questions

4PTS – Answered all follow up questions with complete thoughts and 2-3 sentences each.
3PTS - Answered all follow up questions with complete thoughts and 1-2 sentences each.
2 PTS- Answered all follow up questions with incomplete thoughts and 1-2 sentences each.
1 PTS- Answered one of the questions