WAMC Lab Template

Math Concept(s): Calculate Slope as Rise over Run

Source / Text:

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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 be introduced to the idea of slope of a line as calculated by Rise/Run for paper airplanes they make and then fly.

Lab Plan

Lab Title: Slope of the path of a Paper Airplane

Prerequisite skills: Measuring with accuracy, Units of measurement, division, fractions, and integers

Lab objective: By the end of this lesson, students will be able to calculate the slope of the path of a paper airplane using the formula: Rise / Run, demonstrating understanding through accurate measurements and calculations.

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

Mathematics K–12 Learning Standards:

- HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
- HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima.

Standards for Mathematical Practice:

- Make sense of problems and persevere in solving them.
- Use appropriate tools strategically
- Attend to precision.

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

Reading Standards for Informational Text (Grades 9-10):

- 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.

- RI.9-10.3: Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them.

Writing Standards (Grades 9-10):

- W.9-10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
- W.9-10.8: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

K-12 Science Standards

NGSS Standards for Grades 9-12 - Engineering Design:

- ETS1.A: Defining and Delimiting Engineering Problems
- HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

PS2.A: Forces and Motion

- 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.
- 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.

CCC2: Cause and Effect

- HS-CCC2.1: Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Technology

Empowered Learner (Standard 1.c):

- Students use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways(Educational Technology).

Knowledge Constructor (Standard 3):

- Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts, and make meaningful learning experiences for themselves and others(Educational Technology).

Creative Communicator (Standard 6.c):

- Students create digital artifacts to communicate ideas visually and graphically (Educational Technology).

Engineering

HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

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
☐ Think Creatively
☐ Work Creatively with Others
☐ Implement Innovations
Critical Thinking and Problem Solving
☐ Reason Effectively
☐ Use Systems Thinking
☐ Make Judgments and Decisions
☒ 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
☐ Analyze Media
☐ Create Media Products
Information, Communications and Technology (ICT Literacy)
☐ Apply Technology Effectively

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

Productivity and Accountability
☒ Manage Projects
☐ 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

- 8.5 x 11 inch white paper
- Tape measure
- Writing utensil
- Calculator
- Masking tape

Set-Up Required:

- It would be a good idea to put a line of tape on the floor which serves as the spot for people to launch their airplanes.

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- **1.B.1**: Develop, implement, and communicate new ideas to others effectively.

- **2.D.1**: Solve different kinds of non-familiar problems in both conventional and innovative ways.
- **3.B.1**: Demonstrate the ability to work effectively and respectfully with diverse teams.

Cooperative Learning:

- This lab plan uses cooperative learning by organizing students into teams of three, encouraging collaboration and peer support. Each team will collectively measure, record, and calculate the slope of their paper airplane's flight path, fostering teamwork and communication. Additionally, students will engage in discussions to analyze and compare their results, promoting critical thinking and problem-solving skills within the group.

Expectations:

- The expectations are such that students will make a physical connection to the idea of slope by measuring the vertical height at take off and then the horizontal distance where the plane lands, and expressing that relationship as a fraction.

Timeline:

- This lab can take 45-60 minutes.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- Understanding the slope of a line holds significant practical relevance across various disciplines. Engineers rely on slope calculations to design safe and efficient structures such as ramps and roads. Economists use slope to discern trends in data, while environmental scientists apply it to study changes in natural phenomena over time. By applying the concepts learned in the lab, students gain insight into how mathematical principles underpin essential aspects of everyday life and professional fields, fostering a deeper understanding of their applications in solving real-world problems.

Career Applications

- Understanding the concept of slope has several career applications across different fields. Engineers use slope calculations extensively in designing infrastructure like roads, bridges, and buildings to ensure structural integrity and safety. Architects apply slope principles when designing roofs and drainage systems to manage water flow effectively. Urban planners utilize slope analysis to plan for sustainable development and manage land use. Additionally, careers in data science and economics rely on slope for analyzing trends and making predictions based on data patterns.

Optional or Extension Activities

- One way to expand this activity is to discuss the slope for planes that fly the farthest and those with the shortest flights. Another option is to explore the significance of the slope's sign. Due to gravity, all slope measurements will be negative. What does it signify when there's a positive slope? Do airplanes ever encounter positive slopes? Additionally, students can investigate how different paper airplane designs affect the slope of their flight paths, encouraging them to apply their understanding of slope to optimize flight performance.

Lab Instructions:

Prepare the Paper Airplanes:

Fold your piece of 8.5 x 11 inch paper into a paper airplane of your choice.

Measure and Record:

In your group of three, designate roles for launcher, measurer, and recorder.

Launcher: Stand behind the masking tape line and launch the paper airplane.

Measurer: Measure the horizontal distance (run) from the launch point to where the airplane lands. Also measure the vertical distance (rise) from the ground to where the airplane is launched.

Recorder: Record the horizontal distance (run) and vertical height (rise) at which the airplane was launched.

Calculate Slope:

Using the recorded values of rise and run, calculate the slope of the paper airplane's flight path using the formula: Slope = Rise / Run.

Repeat and Analyze:

Launch the paper airplane multiple times and record each flight's rise and run.

Calculate the slope for each flight and compare the results within your group.

Discussion:

Discuss the meaning of a negative slope in relation to the flight path of the paper airplane. Why are all slope measurements negative?

Consider scenarios where a positive slope might occur in the context of paper airplane flights. Do any of your flights demonstrate a positive slope?

Conclusion:

Summarize your findings and discuss any patterns observed in the slopes calculated. What is the slope of the plane that flew the furthest? How does that slope compare to the plane that flew the shortest?

Reflect on how the concept of slope applies to real-world scenarios beyond paper airplanes, such as in engineering and physics.

Assessment:

Formative assessment: teacher can interact with the different groups and observe, ask questions, and clear up any misconceptions.