WAYNE STATE UNIVERSITY

STEM Day Lesson Plan

Title: Set Sail with STEM: Exploring Motion with sail-powered vehicles

Subject Area: Science- Technology-Engineering

Learning Activity Description:
Students will design and construct sail-powered wheeled vehicles. Using mini-fans to create "wind power", they will test the motion of their vehicle across the floor using digital motion sensors, and make modifications to their vehicle based on the data they collect to explore how "wind" can propel objects forward at varying rates of speed.

Lesson Activity Objective:
To explore how wind can propel objects forward at varying rates of speed:

- MS-PS2-2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
- MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- 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

Lesson Activity Outcomes:
Students will design, construct and race sail-powered wheeled vehicles. They will use motion sensors to test for factors that optimize the speed and forward distance travelled by their vehicle.

Materials/Supplies Listed:
Each student

- Sail- Powered Wheeled Vehicle **Engineering Kit** PITSCO 40311

1 for each group as individual vehicles tested:

- Battery powered hand fan
- TI 84+ CE Calculator
- Motion Sensor TI CBR

Teacher Procedures:
Welcome.

- **Driving Question:** What elements of engineering are optimal for a wind-powered wheeled vehicle to travel the most distance for the longest amount of time?
- Distribute kits, data pages. Give instructions for building the vehicles, and completing the design part of the data page
- Supervise each group as they conduct 2 trials of testing their vehicle. Ask questions to guide modifications to improve the results of each race.
- The "winner" from each group will compete in a 3rd and final trial
- Direct students to describe the features that optimized the winning vehicle and to use evidence from the previous trials to support their reasoning

Preparation Time for Learning Activity:
20 minutes: Distribute kits, review directions, Design and build vehicles
20 minutes: Review instructions for using Motion Sensors, procedure for "racing" vehicles and collecting data. Test vehicles. Modify design/construction of vehicles, conduct Final "race" and collect data. Analyze which features were optimal for creating forward motion of vehicles.

Room set-up:
Design & Build- Tables for 4-5 students
Test & Modify- Need "test-track" space of 5 meter length for each group – may use hallway, need smooth floor surface

Group Strategies (example, group size, expected time for groups, etc.)
Whole class sub-groups of 4 -5 students to work on construction and testing of their vehicles. Each "team" will have a "winner" to compete in a "finals" race

Student Products/Artifacts/work pages:
Attached

Assessment Criteria/Rubric:
Student performance- build and test vehicle, completed work-page including design, data collected from testing of vehicle, using evidence to support claims relating vehicle design to its rate of motion

Closing/Transition to next activity:
Announce winner of "race"
Clean up materials, supplies
Get directions for next session

Name:

Set Sail with STEM: Exploring Motion with sail-powered vehicles

Driving Question:

What elements of engineering are optimal for a wind-powered wheeled vehicle to travel the most distance for the longest amount of time?

Design strategies:

- **How do you plan to build/modify your vehicle so that it can travel the farthest distance using the power from the fan? Describe or sketch your vehicle**

Trial	Distance traveled (centimeters)	Time in motion (seconds)	Design strategies/changes
FINAL			

Describe the vehicle that traveled the farthest and longest time. What design features can you identify as optimal for this vehicle? What evidence do you have to support your claim?