STEM Connections

CO_2 Dragsters

Below are ideas for connecting the CO_2 Dragster activity to STEM concepts and principles. For more ideas and detailed STEM lessons, consult *The Engineered Dragster Teacher's Guides*.

ACTIVITY OVERVIEW

Students design, build, and test CO_2 dragsters.

SCIENCE

Relating Mass and Acceleration

When CO_2 dragsters race, the same amount of force is exerted on each dragster by its CO_2 cartridge. So if all other factors are ignored (friction, drag, and so on), then the dragster with the least amount of mass will have the greatest acceleration and will travel down the track in the least amount of time.

Have all students design and construct a CO_2 dragster, following all safety precautions. Dragsters must have a minimum mass of 45 g. Students can design their dragsters for speed or for aesthetics as they choose.

When this is completed, students will race their dragsters down a 20-meter (65.5 feet) track. Before the racing starts, students should hypothesize how the cars will finish – if the lightest one will win, the most aerodynamic-looking will win, or other ideas they may have.

The dragsters should be timed as accurately as possible. Students record their dragsters' mass and time in a class data table/spreadsheet. Sort the data by time and have students analyze how the mass trends as times increase. Have them write a statement comparing the relationship between mass and acceleration of CO_2 dragsters. Introduce the equation force = mass x acceleration.

ENGINEERING

Iterative Design

In this activity, students will work through a number of iterations of the Design Loop process, based around the CO_2 dragster.

Have all students design and construct a CO_2 dragster, following all safety precautions. The dragster must have a minimum mass of 45 g.

When this is completed, students should do three runs of the dragsters on a 20-meter track, recording the times and averaging them in a data table.

When this is completed, students are encouraged to make design modifications to their dragsters to increase speed. Equipment such as wind tunnels and roll test ramps can provide some qualitative and quantitative information for students to base decisions about potential design changes.

Students should keep a record of design changes and their reasoning for making a specific change in an engineering notebook. After the design change has been implemented in a prototype, each dragster is tested again on the racetrack and the results recorded.

Students should go through at least three different iterations – and more if time allows. Students should compare and contrast design changes that were made.

TECHNOLOGY

Video Analysis

In this activity, all students will design and build a CO_2 dragster that will go down a 20-meter track as quickly as possible. The dragster should be designed and constructed following all safety precautions.

After students have their dragsters completed, the racetrack area should be set up so that the entire 20-meter track is visible in the frame of a video camera. Depending upon the software being used and school or class regulations, phone cameras may be used by students to record their dragsters going down the track.

Inform the students that their dragsters' data will be analyzed in one-meter segments as they go down the track. Have them theorize at which interval the acceleration will be greatest and at which interval the velocity will be the greatest.

Using video-analysis software, such as Vernier's *Logger Pro* software or tracker software, students should determine and record the velocity and acceleration of their dragsters at one-meter intervals down the track.

Have students compare their data to their theories of which intervals would have the greatest acceleration and velocity.

MATH

Determining Frontal Area

In this activity, students will use various tools to determine the frontal area of a dragster. The frontal area of a dragster is determined by the front view of the dragster – indicating the areas that air molecules will collide with the dragster as it travels down the track.

Frontal area of a dragster is important, as it is a major component of frontal drag – one of the forces that slows down the forward progress of a CO_2 dragster.

Students can do a technical drawing of the front view of their dragsters and then use common figures (rectangles, circles, triangles) to estimate the frontal area of the dragster. The area of each figure should be calculated via their area formulas, and the sum of all the figures will estimate the frontal area of the dragster.

Students can also use a camera (from their phones if allowed) to take a front view shot of the dragster. This can be printed, and once again common figures can be used to estimate the frontal area of the dragster.

If available, students can draw the front view of their dragsters in a CAD program and have it determine the total of all the bound areas within the figure.

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