Lesson 11: Teacher Reference 1

Demonstration Setup Instructions

The purpose of this demo is (1) to collect evidence that the forces on an object moving at a constant velocity are balanced and (2) to establish a way to measure friction. To do this, we use a constant velocity car with a spring scale attached that pulls a small block of foam (chosen to parallel the use of foam to represent tectonic plates in this unit), which in turn has a box with a spring scale dragging behind it.

PREPARING THE CARS. This demo will be conducted with 2 cars at different speeds in order to show that sliding friction is not dependent on speed. To make one car move more slowly than the other, you need to put a placeholder in the spot of one of its batteries.

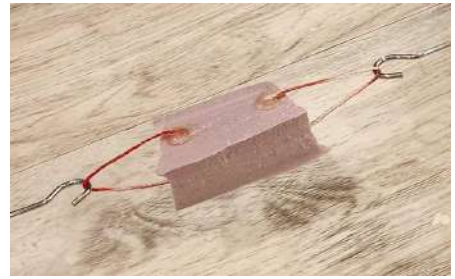
Use foam or cardboard to create a block the same size as a C-cell battery, and wrap it in aluminum foil. Use a small screwdriver to open the battery compartment. Place 1 C battery and the foil-covered placeholder in the battery compartment, and resecure the battery cover with the screw. Place 2 batteries in the other car, and make note of which color car is the slower car and the faster car.

ZEROING THE SCALES. Review the Teacher Reference Zeroing Spring Scales Horizontally. It will help you determine whether you need to permanently modify the 1N spring scale so it can be zeroed in a horizontal orientation. It also outlines the steps to follow if you need to make that modification.

PREPARING THE SCALES. Use sticky tack to attach a 1N spring scale to each of the 2 cars, with the measuring hook facing backward. Be sure the scale is level. This can be accomplished by putting the end of the scale through the windshield of the car, as shown. (Note: the string loops attached to the back of the car in the image are not necessary for this demonstration.)

Use sticky tack to attach a 1N spring scale to the top of the empty cardboard box, as shown. These boxes are equal in height to the cars, so the scales should be at approximately equal heights. Another box may be substituted, as long as the heights of the scales are equal. Calibrate the scales using the screw knobs on the static end so the reading is zero while horizontal. There will be some wiggle around zero that may stick a little due to friction; this is OK. Get the scales as close as possible to zero to start.

PREPARING THE FOAM. Cut a small block of foam. This block should be light enough that it doesn't get weighed down or touch the ground while being dragged. We used a piece about 2 inches by 2 inches, but the exact size doesn't matter. Cut 2 short pieces of string, and hot glue the string to the foam block to create a loop on both ends of the block, as shown.



TESTING THE DEMONSTRATION. Hook up the parts of the system as seen at the top of this document. Start the test by turning on the slower car and letting it run across your classroom floor, dragging the foam and box with it. The scales should read the same amount. Test the demonstration with the faster car to make sure it still runs smoothly, and add mass as needed

to make the procedure work with both cars. If the force shown on the scales is too low to read well, add mass to the box to increase the friction force. If the friction force is too high, the car will tilt back as it runs. If this happens, use sticky tack to attach something with mass to the front of the car. If the scales don't start at zero, start the system with a little slack so as not to begin with a measurement of static friction.

To see the demonstration in action, watch this video: https://youtu.be/Xg5_4pw3DOc .