ACTIVITY 3: MEASURE THE SPEED OF DRY ICE

Image Credit: Gary Abud, Jr.

In this activity, students will conduct an experiment to measure the speed of a dry ice block. Depending on the learners' ages, this could be done as a whole-group activity or completed* in small groups. Either way, start by asking students what two things we need to measure in order to determine the speed of a moving object (e.g., distance and time).

Make a connection to speed limit signs, e.g., "25mph means for every 1 hour (time) driven, a car would have traveled 25 miles (distance)." To make clear this idea, ask students if they need to be driving for an entire hour in order to be traveling at a speed of 25mph. Discuss with them how 25mph is a unit rate based on a measured distance and time ratio that can be used to describe or predict things about motion. For example, if a car were traveling 25mph, ask them to predict how far it would drive in two hours.

Explain to them that because we can't get out on the water and measure the speed of a surfer, they will be conducting an experiment to estimate the speed of a block of dry ice moving across a *surf*ace—get it? The block of ice is going to represent a surfer and help us to model the motion of someone eFoiling. They will need to measure the distance traveled by the block as well as the time as it slides along the surface. Because the dry ice doesn't *actually* touch the surface, it travels at a constant speed, much like someone eFoiling is just above the water.

Materials & Setup **(See a demonstration here!)**

- waterproof winter gloves or oven mitts
- blocks of dry ice
- butcher paper & markers
- measuring tape or meter stick(s)
- stopwatch

Set up a strip of butcher paper along the side of the track where the dry ice will move, but not cover the entire surface. Place one or more meter sticks end-to-end along the length of the butcher paper. This will allow you to mark the position at different time intervals (e.g., 1s, 2s, 3s, etc.)

First, practice the procedure with a demo. Have everyone watch as two volunteers move the dry ice back and forth with gloves on. Make sure to push the block slowly so there is enough time to record its position at different time intervals. Have another person with a stopwatch going. Once you've practiced pushing the block to move in as straight a path along the track as possible, practice having the stopwatch reader call out "now" each second on the second while another volunteer practices putting an imaginary dot along the track at the location of the front edge of the block on the butcher paper near the meter stick. After everyone is feeling comfortable with the procedure, you're ready to begin collecting data.

Next, conduct several trials. The stopwatch can be going before the block begins moving. Once the block is released, the timer calls out "now" every second on the second while the marker makes a dot on the paper near the meter sticks where the front edge of the dry ice is every second until the block reaches the other side. Label each dot as the second it was recorded (e.g., "1s" "2s" etc.) With different colored markers, repeat the procedure a few more times to get more data.

Then have students analyze the spacing between the dots for each trial. Ask them what they notice? They should point out that the dots are evenly spaced apart, signifying the block is moving at a constant speed once it is released. Have students record the position marking on the meter stick for each dot at each second in a data table with time in seconds as one column and position in centimeters as the other.

Last, use the data from the table, determine how far the block traveled in total distance from the first to last measurement, how much time passed, and generate a unit rate in cm/s.

**Note: If concerned about students handling dry ice, this experiment can be done using video footage. Have a person recording the entire scene in one frame without moving the camera such that the meter stick measurements could be read by the viewer.*